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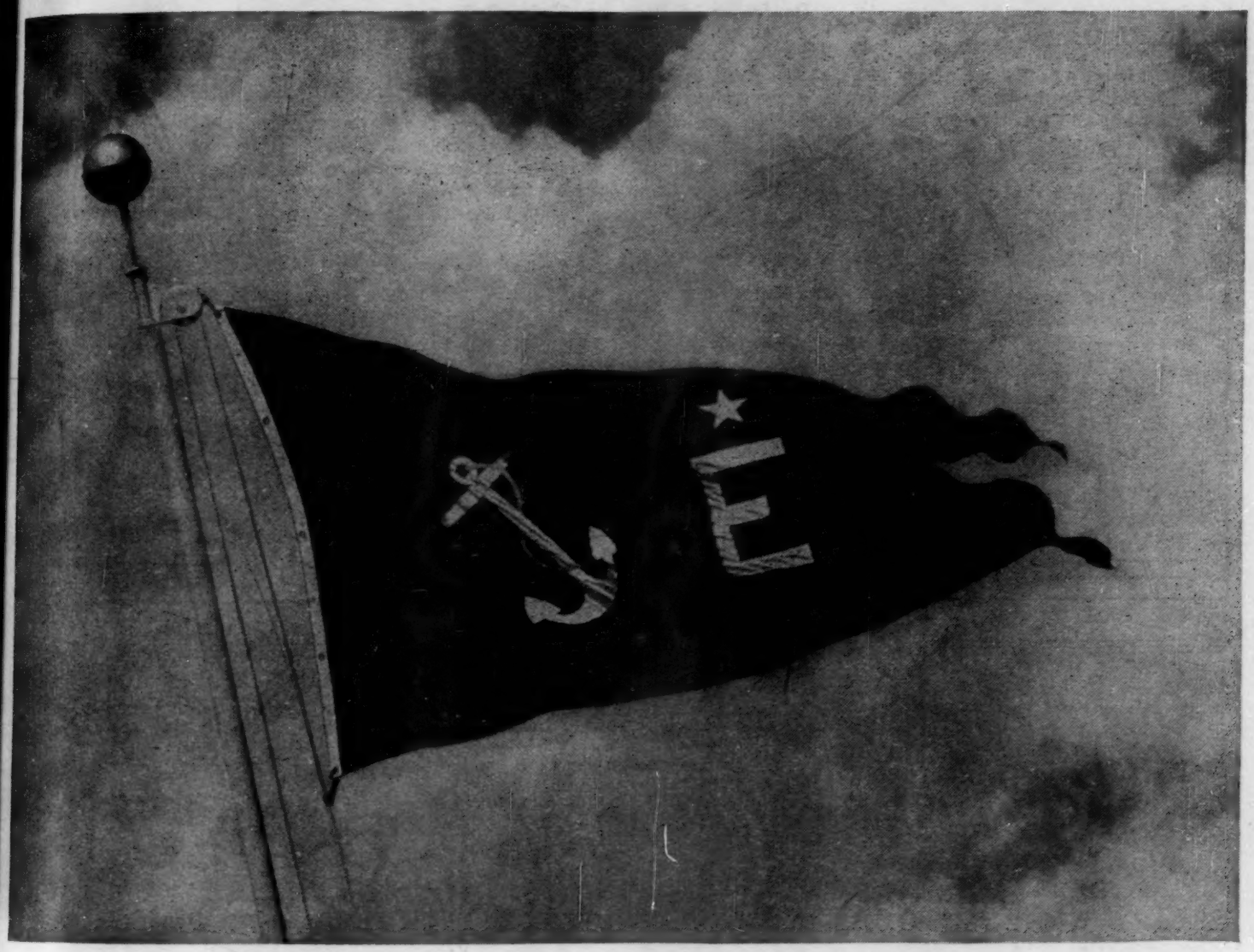

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THE RESPONSIBILITIES OF MEDICINE IN WARTIME[1]

By Dr. FRED W. RANKIN

LEXINGTON, KY.

MEDICAL EDUCATION

THE needs of both the military and the civilian population for adequate medical care emphasize the danger of reduction of either the present-day standards of medical practice or the number of physicians. At present approximately five thousand physicians are graduating yearly from the seventy-six accredited medical schools of the country. When one considers, however, that the loss due to death, retirement and other causes is approximately three thousand a year, it becomes apparent that it is impossible to build a reserve pool of any size in a short period.

The standards of medical education in this country to-day undoubtedly are superior to those found in any other country in the world. Our public has available to it a quality of medical service elsewhere unsurpassed. One of the main problems in medical care is and has been for many years a distribution of talent, for admittedly the concentration of physicians in urban areas has been too great, whereas the dilution among rural populations has been a major and perplexing affair. However, this question of distribution of more physicians and of maintaining present medical standards is one which we can hardly expect to be satisfactorily solved during the present period. The method of production of more physicians and of maintaining present medical standards is one which

[1] Concluding portion of the president's address before the American Medical Association at the ninety-third annual session, Atlantic City, N. J., June 9, 1942.

demands untiring scrutiny and should not be decided in a hurried manner under pressure of emergency.

POSTGRADUATE EDUCATION

Postgraduate education, as it is carried out at present, must inevitably suffer from wartime circumstances. Continuing education as it is applied to general practitioners and specialists differs materially because of the very nature of the essential instruction. The education of a specialist has been largely influenced by the wide-spread adoption of the residency system of training. Within the past three decades this system of apprentice teaching in the wards, plus a long term service in hospital after graduation, has spread to most parts of the country. It is definitely recognized, although somewhat belatedly in hospitals in many larger cities, that residencies are the most useful method of teaching young men surgical diagnosis, surgical judgment and handicraftsmanship under controlled conditions. The length of time devoted to specialized training in the various fields naturally differs but, measured by whatever yardstick one may use, ranges from three years upward, following a year's rotating internship.

That this type of training successfully answers the professional requirements of all specialized groups is beyond cavil; that it is practicable in wartime and under the stress of emergency is distinctly debatable. Younger physicians who have just completed or are in the process of completing a relatively long term of specialized instructions obviously comprise the group which can furnish most useful professional services in specialized fields to the armed forces, for the tempo of modern warfare is so exhausting to even those of superb physical stamina that it is the policy of the War Department to utilize younger officers with troops if they can be found available. Because of these circumstances in which men in residencies and entering the age group for residencies find themselves, it is distinctly probable that much dislocation will be inevitable in postgraduate instruction in specialized fields. Nevertheless, the principles of continuing education along specialized lines must be recognized and adhered to with whatever flexibility allows its most advantageous adjustment in the mosaic of wartime medical education.

It is worth while to note here that an opportunity to continue their professional apprenticeship will be given, wherever possible, to those men who are in the midst of their specialty training and have been called into service. Some of the specialty boards have already agreed to apply the time spent in acceptable army hospitals on the training time required by that board. Only a small number of men can enjoy this privilege because of the exigencies of the times, but the principle of postgraduate education is so fundamental that it must be maintained in wartime in every available institution.

Basic principles in medical education must not be jettisoned; they may be held in abeyance, but the enormous damage which becomes unavoidable in the wake of war may be mitigated by every endeavor to maintain as high a level of both practice and education as is humanly possible.

RESEARCH

Research is a part of a planned postgraduate medical education, which languishes under the exigencies of catastrophe. To date the effect of the present-day war on research has been to direct its attention mostly in channels of military medicine, and from these efforts unquestionably many advantageous developments in special research regarding useful drugs and other substances in the treatment of wounds, shock, infections and burns have resulted. The inevitable letdown in experimental investigation in postgraduate medical education may properly be bridged over but feebly during this period, yet a comprehensive view of the situation suggests that all efforts at maintenance of as many opportunities for scientific research as possible, within the emergency program, are necessary.

It happens that not infrequently science is exposed to programs and tendencies which, because of political considerations, may justifiably be viewed with little enthusiasm and often with forebodings. Obviously, scientific bodies must remain independent; their work should never be influenced by either political expediency or legislation. While it is easy to argue the thesis that such organizations remain within the framework of government, of necessity the hazards of governmental subsidization must ever be kept in mind because of "the danger that he who pays the piper may call the tune and that research may be required to be devoted primarily to objects which the politician, or the civil servant, regard for the moment as of national importance."

Research is a part of scientific development which no longer need be carried on in the sabbatical solitude of a laboratory but may be indulged in by all who wish. Every clinician, every practicing physician, is a research worker in a true and practical sense. Observation of symptoms, observation and recording of the action of therapeutic agents as applied to disease and the correlation of clinical data are obviously of comparable importance in the general scheme of application of medical knowledge. We clinical men of medicine must recognize the necessity of a proper balance between scientific research and clinical investigation and remember the urgent necessity of this dual approach to all problems of healing the sick. Tolerance should temper the interchange of views between the group of academic teachers habituated to

investigation and that part of our profession inclined solely to clinical practice.

TRENDS IN MEDICAL PRACTICE

Among the interesting developments of the first questionnaire which was sent out to the medical profession was the surprising fact that only 41 per cent. of the physicians classified themselves as general practitioners. Of the remainder, 25 per cent. were classified as full-time specialists and 34 per cent. as part-time specialists, the latter group indicating that they paid particular attention to some special line of work while at the same time carrying on a general practice. Thus it becomes apparent that approximately one medical man in three is devoting his entire time to a specialty. That these specialists are of varying degrees of proficiency and training is beside the point, for their numbers indicate definitely a trend in the practice of medicine which is apparently most satisfactory to both the public and the profession, and therefore the number of specialists is likely to increase rather than otherwise. Such a trend has been quite apparent to the most casual observer over the last two decades, and the profession itself, as is its wont, has taken steps to evaluate the capabilities of specialists through the establishment of authoritative examining bodies in fifteen special fields.

This development of specialty boards is a milestone on the road of medical progress which represents self-imposed restrictions and standards of training on physicians who elect to practice in limited fields. It is a part of the scientific discipline of medical men which began in the nineteenth century and has been maintained until to-day. These boards are like licensing boards, which were established primarily for the protection of the public except that they interest themselves only in standards of training, ethics and proficiency. They do not seek to interfere with any freedom of action of medical schools or licensing bodies or hospitals, and certainly their usefulness would be decidedly impaired should they undertake to arrogate to themselves such prerogatives. It should be emphasized here and now that these boards were formed by groups of specialists with the approval and consent of the Council on Medical Education and Hospitals of the American Medical Association and the Advisory Board of Medical Specialists. In no sense was pressure applied in their birth, and operation under the auspices of national authoritative bodies has been one of their basic principles. That they were formed in the spirit of idealism and that the members of the boards have performed a monumental service which has demanded sacrifice of huge amounts of effort and time from their various other duties is, I think, worth pointing out. As a member of one of these original boards, I can testify to the conscientious fairness and undeviating sense of duty with which each candidate, not only for certification by examination, but in the Founders' Group, has been scrutinized. It is with considerable pride that I assure you that in no instance as far as the Board of Surgery, with which I am most familiar, is concerned, has any decision been arrived at save on merit.

That there are two dangers from which specialty boards are not entirely free must be admitted: first, that there be too many specialty boards and, second, that the boards, because of their very independence, make certain decisions affecting medical education or hospital staffs, which could be adjudged either as arrogant or dogmatic and therefore harmful.

Relative to the number of boards, it may be pointed out that the Board of Internal Medicine, for example, has appointed a Committee on Medical Specialties in the fields of allergy, cardiovascular disease, gastroenterology and tuberculosis. Each candidate in these specialties must first pass the general examination of the parent board, and members of the board of examiners will sit in with the subspecialties in evaluating all candidates. This seems a wise provision if subspecialties are to be recognized by special certification, since it presupposes that the candidate is adjudged a competent physician in general internal medicine before he undertakes a more confined field of specialization. Too many boards for minor specialties can add confusion and destroy much of the usefulness of the general plan, but, as long as parent boards supervise examinations and give certificates only after the basic requirements of a major specialty have been satisfied, there is small likelihood of this development occurring.

Enthusiasm for service should continue to be one of the outstanding characteristics of specialty boards, but this enthusiasm should be tempered with common sense, practicality and freedom from any savor of applying pressure. That their programs must be flexible enough to meet changing demands is a truism, and that their decisions must be of an elastic form albeit tempered with resolution and foresight is essential to their continued usefulness. These boards have performed a service to the profession and the public by identifying the well-trained and competent specialists, and for this accomplishment they deserve tolerant cooperation, thoughtful scrutiny and helpful constructive criticism.

OUR OBJECTIVES AND OBLIGATIONS

Our nation has now passed from a stage of prebelligerency into a phase of mobilization and active participation in warfare. We have emerged from a stage of preliminary training to take station in battle lines. Our forces are already fighting on many battle fronts

and in foreign seas. War is now our principal business; all national efforts are ancillary to its successful termination in a permanent peace by decisive victory. In this struggle the entire nation is mobilized and, as an integral part of its citizenry, the medical profession cheerfully and enthusiastically offers its all. Our profession is the trustee of the nation's health, and as such its obligations are to furnish adequate medical care to the armed forces while at the same time maintaining faithful service to the civilian population and productive war industry installations. It further demands that public health programs be cheerfully guarded, maintained or even increased as the need grows larger and larger. We are committed to the decision that provision for graduate education and for special education to develop specialists be continued at their present high level of efficiency. These and other essential duties which unfold continually in our daily duties must, and will be, accepted and accomplished to the extent of our capacity. In the inescapably somber times ahead, often our fortitude will be challenged, often our ideals will appear frustrated by circumstance; but the true mettle of a profession emerges only when tried in the fires of adversity.

Changes, unavoidable and unpleasant, face us in our daily and professional lives; we do not speak of the inevitable essential sacrifices; we speak rather of the glories of service. To serve is our destiny, to serve freely, faithfully and effectively is our wish and ambition.

Our duty is plain to see: we shall go forward to our task, and we shall not fail.

INFRARED RADIATION

By Dr. N. C. BEESE

WESTINGHOUSE LAMP DIVISION, BLOOMFIELD, N. J.

ALL bodies, whether they feel hot or cold, emit infrared radiation, or what is usually classed as heat. Hot and cold are relative terms. A so-called hot body radiates energy faster than the human body, while a cold body radiates energy at a slower rate than human bodies do.

Infrared radiations are electromagnetic vibrations, similar to visible light but of longer wave-lengths. They extend from the visible red radiations of about 7,000 angstrom units to some arbitrarily selected limit such as 5,000,000 or 10,000,000 angstrom units. At this point the radiations approach the region of the shortest radiations produced by ultra-high-frequency radio tubes.

Several physical laws that can be defined with mathematical formulas describe the principal phenomena of radiant energy from a black body, which is defined as a perfect non-selective absorber and emitter of radiations. The amount of energy radiated per unit area at any temperature is given by the Stefan-Boltzmann Law $E = \sigma T^4$. In this formula E = energy; $\sigma = 5.73 \times 10^{-5}$ ergs per cm^2 per sec; T = absolute temperature in Kelvin degrees (centigrade degrees plus 273). The relationship $\lambda_{max} \times T = 0.2886$ centimeter degrees is derived from Wien's displacement law; λ_{max} is the wave-length at which the radiated energy is a maximum. For every given temperature there is a wave-length at which the radiated energy is a maximum.

Another useful relationship is known as Planck's radiation law. It gives the intensity I of radiated energy for every wave-length and every temperature T. Expressed mathematically,

$$I_\lambda = \frac{A\, c_1}{\lambda^5 \left(e^{\frac{C_2}{\lambda T}} - 1 \right)}$$

in which A is the surface area and c_1 and c_2 are constants. This is a complex but highly accurate formula.

By applying these formulas one can learn several interesting things about radiation in general and about infrared radiation in particular. Table I shows a comparison of relative energy and wave-length of maximum radiated energy of a black body at several selected temperatures.

TABLE I

TEMPERATURE-ENERGY-WAVE-LENGTH CHARACTERISTICS OF A BLACK BODY

Selected Temperatures	max (microns)	Relative Energy
90°K (Boiling point of liquid oxygen)	32.1	0.000064
273°K (Melting point of ice)	10.55	0.0055
373°K (Boiling point of water)	7.75	0.019
1000°K (Approx. temp. of radiant electric heater)	2.89	1.00
2500°K (Approx. temp. of filament in drying lamp)	1.15	39.0
5300°K (Approx. temp. of surface of sun)	0.55	800.

The second column shows that the wave-length of maximum energy shifts toward shorter wave-lengths, as the surface temperature of a body is increased. This shows numerically that as a body is heated it goes through the color changes of dull red, bright red, yellow, white and at extreme temperatures it appears bluish white. In addition to color change the total radiated energy increases rapidly, the third column of the table shows.

By plotting Planck's equation for several temperatures one can see the shift in wave-length. Fig. 1 shows the energy distribution for several different temperatures, with energy at the wave-length of maximum radiating power maintained at unity. The points of maximum intensity are related by Wien's displacement law. The curves for melting ice and boiling water are relatively close together in the electromagnetic spectrum, yet these two substances typify sources of uncomfortably cold and hot sensations. By applying the Stefan-Boltzmann formula one learns that the energy radiated per unit area of a black body at zero degrees Centigrade is 29 per cent. of that radiated by a body at 100 degrees Centigrade—a surprisingly large value.

transparent to visible and near-infrared radiation. Glass is opaque to ultraviolet radiation shorter than 0.3 micron and also to infrared radiation longer than about 2.5 micron. The energy-distribution curves show that much of the radiant energy of the high-temperature radiators passes through window glass, but relatively little gets through from low-temperature radiators. This is the scientific explanation of the fact that the interior of an automobile with windows closed becomes unbearably hot in the summer sun. Upholstery absorbs some of the visible and near-infrared radiation shorter than 2.5 microns and converts it into radiation of longer wave-length. This long-wave heat energy can not get out of the car by radiation because glass and metal are opaque to it,

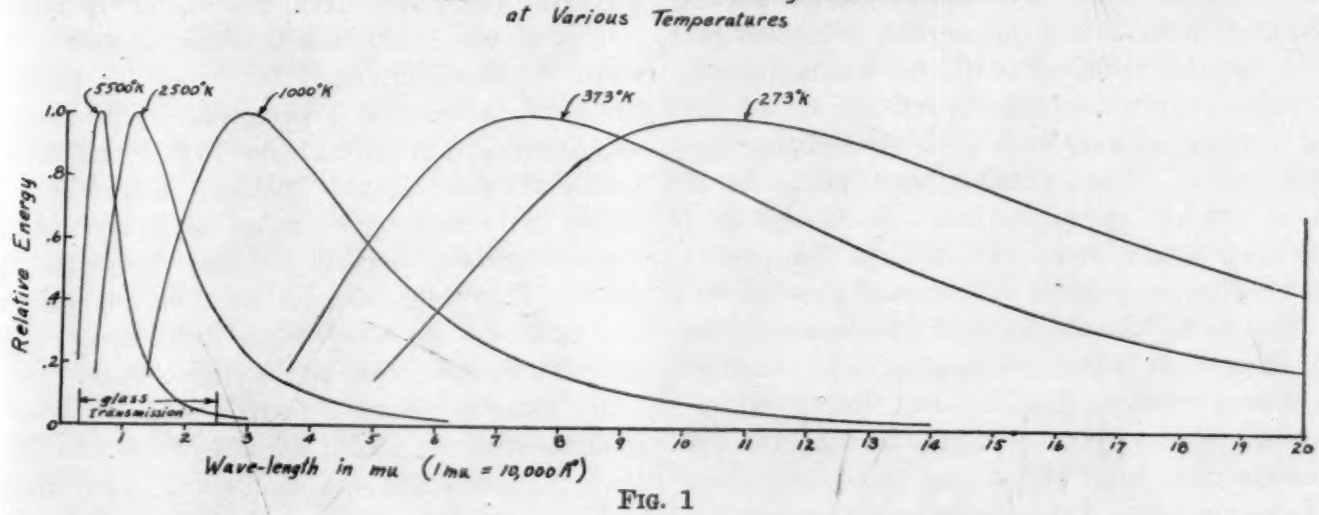

FIG. 1

MICRO WAVES FROM LIQUID HELIUM

By applying Wien's displacement law to a substance like liquid helium at its melting point (0.78 degrees Kelvin) one calculates the wave-length of maximum energy to be 3.7 millimeters. In the region of from 2 to 10 millimeters the energy is more than 20 per cent. of the maximum. This means that a flask of liquid helium is a thermal submicro-wave generator emitting extremely short radiations bordering on the region of shortest ultra-high-frequency radiations produced by electronic tubes.

There are several factors, neglecting availability, that prevent helium from being used practically as a generator of submicro waves. First, the total energy is insignificantly small as calculated with the aid of the Stefan-Boltzmann formula. Also, no single specific wave-length can be selected, for the entire band is generated and all possible phase relations exist. Relatively few atoms have exactly the same frequency of vibration and phase relationship at any one instant and hence preclude the generation of tuned radio-frequency oscillations.

TRANSMISSION OF RADIANT HEAT THROUGH GLASS

Fig. 1 shows a wave-length region in which glass is so the energy density of heat radiation builds up to an uncomfortable degree.

Practical and desirable use can be made of this knowledge in the scientific construction of greenhouses and poultry houses where heat and sunlight are desired in winter. By judiciously using glass only where it will do the most good, such as on the south side of the building and part of the roof, much heat and light can be obtained free from the sun's rays. A glass-enclosed "sun porch" on the south side of a house may be comfortably warm without artificially heating on a sunny winter's day, even though the outside air be quite cold. The same natural laws that cause a closed automobile to be uncomfortable in summer can be used to good advantage in supplying heat to buildings in winter.

ROOM HEATING BY RADIANT ENERGY

Several years ago experiments were performed in the Westinghouse Research Laboratory to determine whether walls of a room could be heated by passing current through heater wires embedded in them or cooled by passing cool water through water pipes also embedded in the walls. It was found that the temperature of the walls rather than air temperature was

the controlling factor in determining body comfort. With the walls at a temperature of about 80 degrees Fahrenheit an occupant was comfortable even with an air temperature of about 60 degrees as determined with a thermometer hung in the middle of the room. By cooling the walls to 60 degrees and passing heated air at 80 degrees into the room, one still felt uncomfortably cold. This is a good demonstration of the importance of radiant energy in making people feel comfortable or uncomfortable. This phenomenon might be used in heating special rooms of a sanitarium or hospital.

Medical Application of Radiant Energy

Local application of heat to a part of the body, as with a hot-water bottle or heating pad, is mostly a surface treatment. Heat is transmitted to the tissues chiefly by conduction, and penetration is limited because of the cooling effect of the circulating blood. Radiant energy plays a minor part because of the high absorption of long-wave infrared radiation by body tissues and by the relatively low intensities of radiant energy at that temperature. An incandescent filament gives rather intense radiations in the spectral region where surface tissue is somewhat transparent. Since the outer tissues are semi-transparent the radiant energy can fall upon and actually be absorbed by the tissues requiring local heating. In this application the emissivity of the highly heated filament matches the wave band of greatest transmission and thus allows maximum transmission to sub-surface tissues.

Infrared Transmission through Fog

Visible light is readily scattered by fog so that its penetration is limited. Scattering for blue light is greater than for yellow or red light, so even a white light appears yellowish through fog. This is the same phenomenon that causes the sky to be blue. Long red and yellow rays are readily transmitted through the air with but little back scattering, while the shorter blue rays are so intensely scattered by dust particles and air molecules in the atmosphere that they give the sky a blue color.

By adding microscopic water droplets to air molecules and dust particles even yellow and red light are readily scattered. It is possible, however, that near infrared radiations are capable of penetrating rather long distances through fog. The scattering of light is a function of particle size and wave-length of radiant energy. Water vapor has maximum absorption at about 7 microns, hence radiations somewhat shorter than this can be used efficiently. Infrared rays of wave-length between 3 and 5 microns can be transmitted and measured through dense fog at considerable distances. A suitable and efficient generator of such radiations used with a sensitive detector has many uses in navigation and signal work.

Power from Ice Water

Heat from a steam radiator is used to make homes comfortable in winter. Since the same radiator if filled with ice water would still contain a large amount of latent heat energy (if the heat could be extracted from it) it is interesting to speculate on the possibilities of extracting power from Arctic ice fields. While this is not a problem of radiant energy but rather one of heat transfer to an intermediate substance, the subject is still closely allied with infrared or heat energy.

This problem was carefully considered and worked out in detail by Dr. H. Barjot in an article "Extracting Heat and Power from Ice Water" published in *Power,* March, 1930. His heat engine uses ice water at 32 degrees Fahrenheit for "fuel" to volatilize a hydrocarbon which is a petroleum by-product. The vapor passes through a turbine and is condensed in a tank containing blocks of frozen brine. The brine is frozen in open troughs exposed to the air and attains a temperature of perhaps 6 degrees below zero Fahrenheit. By comparison, ice water is relatively warm and furnishes the temperature differential of 38 degrees Fahrenheit to make the engine work.

Ice water is passed through a mixing valve, where it mixes with the cooled liquid hydrocarbon that has been pumped from the condenser. The mixing of water and hydrocarbon causes the hydrocarbon to "boil" the water giving up the latent heat of ice to form ice crystals while the hydrocarbon absorbs this heat to produce rapid vaporization. The boiler is near atmospheric pressure while the condenser is only from one third to one fifth atmosphere. This pressure differential causes the turbine to operate.

This novel scheme may some day become practical in supplementing the power from rivers in the far north in winter when the flow of water, and hence available power, is lowest. This heat engine works best when air temperature is lowest, which causes the greatest temperature differential between boiler and condenser.

Direct Solar Energy

We burn fuel oil and coal that was formed by chemical processes ages ago, utilizing the radiant solar energy that went into the process of forming the hydrocarbons. Wood and other vegetation formed more recently can be made to release their latent heat energy in the same way. These are stored and transformed forms of energy that originally were supplied by the sun to make the vegetation grow. Dr. Abbot, of the Smithsonian Institution, made a solar engine in which he used direct radiation from the sun to

furnish heat to the boiler. He made a practical operating model that gives promise of working satisfactorily in certain locations. One must select a place where sunshine is abundant, as in the southwestern states, so its field of application is limited. Since it requires the direct radiation from the sun for its operation it can be used only about half the time.

INFRARED SPECTROSCOPY

Spectroscopy in the visible and ultraviolet regions has been used for several decades in detection and analysis of some inorganic elements. During the last 10 years infrared radiations have become useful commercially in a similar manner, but with these radiations one can carry out investigations with organic substances that have hitherto been impossible by any other means. Some atoms or special groups of atoms forming component parts of a complex organic molecule are favorably situated to vibrate as small individual units uninfluenced by the molecule as a whole. Hence these groups may be identified by their absorption spectra in the infrared part of the spectrum.

The water molecule has a strong absorption band at 3.0 microns because of the hydroxyl or OH radical. Other absorption bands are found for water at 1.5, 4.75 and 6.0 microns. Minerals having water of crystallization in the crystal structure should reveal the presence of water by absorption bands at some or all of the places where the water molecule shows strong absorption. Two substances such as selenite ($CaSO_4 + 2\ H_2O$) and anhydrite ($CaSO_4$) illustrate the phenomenon nicely. Anhydrite shows strong absorption at 4.55 microns which is caused by the sulfate (SO_4) radical but does not show the strong water bands. Selenite, however, shows a strong SO_4 band and in addition shows the strong water bands.

Opal ($SiO_2 + H_2O$) shows the characteristic bands of quartz (SiO_2) and also the strong water bands. The CO_2 band at 4.28 microns, the 4.6-micron band of CO and the CH_3 band at 3.43 microns are characteristic of these chemical groups.

In the study of organic substances, infrared spectroscopy is a powerful and useful tool. In the study of plastics and hydrocarbons infrared spectra have added much useful information. In a series of hydrocarbons each single substance gives its own characteristic absorption band. A mixture of two or more such substances registers the composite structure. Having built up a library of absorption-band patterns of many simple substances it is relatively easy to match an unknown pattern to the known patterns to discover the composition.

Because of difficulties of manipulations, infrared radiations have not been studied as intensively as visible and ultraviolet radiations, but with increasing interest centered upon them they will yield much knowledge that can not be obtained by any other method of attack.

OBITUARY

JOSEPH CHARLES ARTHUR

THE death of Joseph Charles Arthur at Brook, Indiana, on April 30 removes one of the pioneer plant scientists in the United States and one of the foremost students of plant rusts in the world. He was connected with Purdue University for fifty-five years as professor of botany, botanist to the Indiana Experiment Station and emeritus professor.

Joseph Charles Arthur was born in Lowville, N.Y., on January 11, 1850, the only son of Charles and Ann (Allen) Arthur. His parents went westward when he was about six years old. They located first near Sterling, Ill., then at Charles City, Iowa, and later at Spirit Lake, Iowa. He received his bachelor's and master's degrees from the Iowa State College and his doctor's degree from Cornell University. He was a member of the first class to be graduated at Iowa State (1872), and his doctor's degree (1886) was the first conferred by Cornell University in the field of science. He studied also at Johns Hopkins, Harvard and Bonn. Later he received honorary degrees from the University of Iowa, Iowa State College and Purdue University.

The ambition to become a botanist developed early in the life of Joseph Charles Arthur. He had that goal in mind before he went to college and was greatly disappointed to find that botany was not being taught when he enrolled at Iowa State College. During his sophomore year Dr. Charles E. Bessey became a member of the faculty at Ames and an immediate friendship developed between the two men. A gifted and inspiring teacher gave an enthusiastic student his introduction to botanical science. Professor Bessey's courses in vegetable physiology and economic plants and lectures on weeds and parasitic fungi were an excellent foundation for a long and distinguished career in applied botany, plant pathology and mycology.

In 1872 the subject of botany had not been recognized by many colleges and universities in the United States, the state agricultural experiment stations had not been founded, and there were no state or national departments of agriculture. Little wonder that a graduate of that time found difficulty in obtaining a botanical position. The modern era of botanical teaching and research was in its infancy.

Young Arthur, however, did not become discouraged in his determination to make botanical science his life work. Eventually it fell to his lot to take up the study of applied botany, he made early contributions to its development, and he was spared to devote an unusually long life to its advancement.

In 1884 he was appointed botanist to the newly founded Agricultural Experiment Station at Geneva, N. Y. For such a research position he was well prepared. He was the first person in America to hold such a position. His study of pear blight carried on there was pioneer work in the field of plant pathology.

In 1897 he was called to Purdue University as professor of botany. The next year his title was changed to professor of vegetable physiology and pathology and botanist to the Indiana Agricultural Experiment Station. In 1901, while serving in this capacity, Dr. Arthur was married to Emily Stiles Potter, of Lafayette, Indiana, who died in 1935. In his immediate family he is survived only by a sister, Mrs. Charles Tradewell, of Lakefield, Minn. Although Dr. Arthur formally retired in 1915 he continued his research and laboratory work at Purdue uninterruptedly for the next twenty years. During his declining years he kept his home in Lafayette but spent the winters either in California or Florida.

During the earlier years of his service at Purdue Dr. Arthur taught courses in plant physiology and in plant pathology. He was much interested in designing and building apparatus to aid in the teaching of plant physiology. Later he devoted most of his time to research in plant pathology and mycology. His work on the cereal smuts and on potato scab was of considerable economic importance. He introduced formaldehyde as a fungicide and was the first investigator to use it for the prevention of potato scab.

Although an important contributor to other fields of botanical science, Dr. Arthur is best known for his studies on the group of parasitic fungi known as the plant rusts. His first paper on the rusts was published in 1882, the last in 1936. During this long period he was continuously investigating the rusts, their life-histories, relationships, distribution and economic importance. In 1899 he began a special series of culture studies which he carried on for nineteen years. The life-histories and host relationships of a hundred or more species were revealed by these experiments. A summary of this work shows that about 2,400 collections were used and that approximately 3,750 cultures were made, each involving the use of a potted plant growing in a greenhouse. During these years a large number of correspondents contributed specimens and field observations. A large percentage of these correspondents were not professional botanists, and many of them acquired their interest, ability and inclination to assist through personal contacts and correspondence with Dr. Arthur. It is a marvelous example of the enlistment of voluntary assistance through boundless enthusiasm and fine inspiration. Throughout his long career Dr. Arthur's work was never limited to the facilities and resources of his institution but extended far beyond that range.

In 1905 a new classification of the plant rust order was published. In 1907 the preparation of a complete taxonomic treatment of the North American rusts was begun for the North American Flora (published by the New York Botanical Garden). This ran into eleven parts consisting of 765 pages and required twenty years for its completion. He published two books on the rusts—a biological treatment in 1929, "The Plant Rusts" (in collaboration with F. D. Kern, C. R. Orton, F. D. Frome, H. S. Jackson, E. B. Mains and G. R. Bisby, all former associates in his laboratories) and a taxonomic treatment in 1934, "Manual of the Rusts in the United States and Canada." In addition to these larger publications he brought out a long list of papers dealing with the varied aspects of the rusts. He determined and reported on collections not only from the United States but also from Cuba, Puerto Rico, Mexico, Guatemala, South America and the Philippines. He made collecting trips to New England, several southeastern states, the Rocky Mountains, Texas, New Mexico and Arizona. He made numerous trips to Europe partly because he was fond of traveling but mostly to look up type specimens in some Old World herbarium, to obtain access to some rare literature, to confer with fellow workers or to attend an international botanical congress where botanical nomenclature was under discussion. He was a delegate to the Congresses in Vienna in 1905, in Brussels in 1910 and in Cambridge in 1930. In 1925 a trip was made especially to confer with European mycologists who had special interests in the plant rusts. It was the privilege of the writer to accompany Dr. Arthur on this trip. Visits were made with twelve botanists in Germany, Sweden, Norway, Switzerland and England. A paper in SCIENCE (Vol. 43, pp. 558–560) entitled "Conversations with European Mycologists" reported the results of the exchange of opinions with fellow workers. This was one of the links in a long chain of cosmopolitan activities forged by Dr. Arthur.

Dr. Arthur belonged to numerous organizations to which he gave at all times his loyal and active support. He was a member of Sigma Xi; the American Society of Naturalists; the American Philosophical Society; the Academy of Natural Sciences of Philadelphia; the Indiana Academy of Science (president, 1893); the American Association for the Advancement of Science (vice-president, 1895); the Society for the Promotion

of Agricultural Science; the Torrey Botanical Club; the Botanical Society of America (twice president, 1902, 1919); the American Phytopathological Society (president, 1933); the Mycological Society of America; the Deutsche Botanische Gesellschaft, and the Russian Botanical Society.

The life and work of Dr. Arthur illustrate the attainments which may be achieved through real resistance to discouragement, industrious habits, sound scholarship, unflagging persistence and high purpose.

FRANK D. KERN
THE PENNSYLVANIA STATE COLLEGE

RECENT DEATHS

SIR JOSEPH LARMOR, from 1903 to 1932 Lucasian professor of mathematics at the University of Cambridge, died on May 19 in his eighty-fifth year.

A REUTER dispatch from Moscow to *The New York Times* dated June 6 reads: "Vladislav Vanchura, Czech author; Professor Storkan, authority on zoology, and Professor Selber, of the Czech Technological Institute, were among those killed by the Nazis in reprisal for the assassination of Reinhard Heydrich."

SCIENTIFIC EVENTS

REPORT OF THE COMMITTEE ON SEDIMENTATION

THE report of the committee on sedimentation of the Division of Geology and Geography of the National Research Council for the year 1940–1941 has just been published. The work of this committee is to prepare summary reports of progress in different fields of sedimentation and to increase the fund of knowledge on special problems. The report this year contains 10 such articles. The most important of these is a set of two charts prepared by R. Dana Russell listing the physical properties of more than 150 minerals that are commonly found in sedimentary rocks. The data are arranged in a new order, which experience has shown enables students to determine minerals more rapidly than formerly. Every student of petrography will find these charts useful.

Another article of special interest is a report by F. J. Pettijohn on the present state of knowledge of quantitative studies of sedimentation. Two reports on diagenetic changes in sediments are included; one by W. P. Kelley on soils and the other by George A. Thiel on calcareous sediments. Other articles are: current literature on recent marine sediments by H. C. Stetson; research on sedimentation in the Soil Conservation Service by C. B. Brown; research on sedimentation in the Gulf Coast region by F. W. Rolshausen; the sediments of Lake Provo, Utah, by H. J. Bissell, and two papers on statistical compilations of quantitative data on sediments, one on alluvial gravels by W. C. Krumbein, and the other on Mississippi delta sediments by August Goldstein, Jr.

The report is issued in bound mimeographed form of 110 pages. The price is $1.00, which includes a set of the two charts. Separate copies of the charts are 50 cents. Orders for the report or charts should be accompanied by remittance and addressed to the National Research Council, 2101 Constitution Avenue, Washington, D. C.

WALTER H. BUCHER
COLUMBIA UNIVERSITY

THE DEDICATION OF THE BAUSCH HALL OF SCIENCE AND HISTORY

THE Bausch Hall of Science and History, the new home of the Rochester Museum of Arts and Sciences, as reported in *Museum News*, was formally dedicated on May 23 with an address by Vilhjalmur Stefansson.

The building, the gift of Edward Bausch, with the property on which it stands, has been planned for complete provision of up-to-date facilities for exhibition, educational work and all the other activities of a modern museum. It is three stories and basement, 115 feet wide and 180 feet long, of buff Indiana limestone.

The equipment includes air conditioning by which the air is completely changed every fifteen minutes and can in case of necessity be changed in the entire building in five minutes, case lighting, concealed fluorescent lighting in the auditorium and on the first floor, under-floor duct system of electrical connections, and ceilings of acoustic plaster and floors of mastic tile. Provision is made for future additions to the structure.

Director Arthur C. Parker has plans for a progressive series of natural science exhibits beginning with astronomy and geology and covering all phases of life on the earth, special displays on man, and an exhibition series on culture history and social science; he has also made provision for cooperative programs with Rochester schools and with clubs and associations engaged in educational, scientific, cultural and civic activities.

THE DEDICATION OF THE TECHNOLOGICAL INSTITUTE OF NORTHWESTERN UNIVERSITY

THE formal dedication of the building of the Technological Institute of Northwestern University took place on June 15 and 16.

The dedicatory ceremonies included a series of industrial and educational conferences, attended by

more than 1,000 representatives of industrial firms, scientific groups and educational institutions.

The speakers included Donald M. Nelson, chairman of the War Production Board; Charles F. Kettering, president of the General Motors Research Corporation; Lieutenant General William S. Knudsen, of the War Production Board; and Jesse H. Jones, U. S. Secretary of Commerce.

Dr. Franklyn B. Snyder, president of Northwestern University, welcomed the delegates at the Monday morning conference. Other speakers were Walter J. Cummings, chairman of the committee on dedication; Governor Dwight H. Green, of Illinois; Alfred H. White, president of the Society for the Promotion of Engineering Education; Dr. Roger Adams, chairman of the department of chemistry of the University of Illinois, and Dr. Raymond Walters, president of the University of Cincinnati.

Current problems in industry and government were considered on Monday afternoon at a conference over which Henry T. Heald, president of the Illinois Institute of Technology, presided. The speakers were Lieutenant General William S. Knudsen of the War Production Board; Martin W. Clement, president of the Pennsylvania Railroad, and Alex D. Bailey, chief operating engineer of the Commonwealth Edison Company, Chicago.

The dinner program on Monday evening was presided over by Kenneth F. Burgess, president of the board of trustees of the university. Donald M. Nelson spoke on "Speeding Production," and Dr. Charles F. Kettering discussed "Cooperative Engineering Education."

Tuesday morning's conference was devoted to the scientific developments of to-morrow in research, industry and education, the speakers being Robert C. Disque, acting president of the Drexel Institute of Technology; Dr. W. F. G. Swann, director of the Bartol Research Foundation of the Franklin Institute; Dr. George O. Curme, Jr., director of research of the Carbide and Carbon Chemicals Corporation, New York; and Dr. Karl T. Compton, president of the Massachusetts Institute of Technology. The dedicatory convocation in the afternoon was held in the entrance court of the building, with seating accommodations of 2,000 guests.

Following an academic procession and the singing of the national anthem, Captain Frank H. Lash, chaplain corps, U. S. N., gave the invocation, after which the keys of the new building were formally accepted by Kenneth F. Burgess, president of the board of trustees, who presented them to Dean Ovid W. Eshbach, of the institute. The dedicatory address was delivered by Jesse H. Jones, U. S. Secretary of Commerce. Honorary degrees were conferred on leaders in American business, government, science and education. A reception for delegates and official guests was held at the home of President Franklyn B. Snyder after the convocation.

The Technological Institute was established in 1939 through a gift of $6,735,000 from Walter P. Murphy, a Chicago manufacturer of railway supplies. Construction of the new building, which contains ten acres of floor area, was begun on April 1, 1940, and was completed about the first of this year. Approximately $1,000,000 worth of new scientific equipment for teaching and research has been installed.

The institute operates on the cooperative plan, under which students alternate a three-month period of study on the campus with an equal period of work in industry. Seventy large industrial firms in 12 different states cooperate with the institute in this program. The present enrolment is 525 students, which will be increased to 800 students in the fall.

THE AMERICAN MEDICAL ASSOCIATION

THE nine hundred and thirtieth annual convention of the American Medical Association opened in Atlantic City on June 1. The association has a membership list of 120,000 physicians and surgeons, of whom about 10,000 attended the meeting.

Colonel Fred W. Rankin, of Lexington, Ky., president-elect, was installed as president at the opening general meeting on Tuesday evening. He succeeded Dr. Frank H. Lahey, of Boston, who delivered the address of the retiring president. The concluding part of Dr. Rankin's address appears in this issue of SCIENCE. At this meeting the annual distinguished service medal was presented to Dr. Ludvig Hektoen, emeritus professor of pathology of Rush Medical College, University of Chicago.

The opening general scientific meeting was devoted entirely to papers by prominent physicians from Latin America and Canada. There were also twenty-five scientific exhibits by physicians from Central and South America and one special exhibit by the Brazilian Government. These exhibits were presented by physicians from Argentina, Brazil, Chile, Colombia, Cuba, Mexico and Peru. A large number of the principal manufacturers and dealers in the United States were represented at the exhibition.

Dr. James E. Paullin, of Atlanta, Ga., who was chairman of the Council on Scientific Assembly, was named president-elect of the association at the final session on June 11, and Dr. W. J. Carrington, of Atlantic City, was elected vice-president. Dr. Edward M. Pallette, Sr., of Los Angeles, was elected a member of the board of trustees to succeed Dr. Arthur M. Booth, of Elmira, N. Y. The name of the committee

on medical preparedness was changed to the committee on war participation.

The association will meet next year in San Francisco; the meeting in 1944 is to be held in St. Louis, providing transportation facilities permit; New York City was chosen as the meeting place for 1945.

SCIENTIFIC NOTES AND NEWS

HARVARD UNIVERSITY, at its 291st commencement exercises on June 11, conferred the doctorate of laws on Dr. Frederick P. Keppel, president of the Carnegie Corporation, retired. The doctorate of science was conferred on Dr. Adolf Meyer, professor emeritus of psychiatry of the Johns Hopkins University; on Dr. René J. Dubos, bacteriologist and associate member of the Rockefeller Institute for Medical Research, and on Dr. Reginald A. Daly, Sturgis-Hooper professor of geology at the university.

AT Yale University the doctorate of laws was conferred on Dr. Vannevar Bush, president of the Carnegie Institution of Washington, and the doctorate of science on Dr. Robert R. Williams, chemical director of the Bell Telephone Laboratories of New York.

THE University of California conferred at commencement the degree of doctor of laws on Dr. Langley Porter, dean emeritus of the School of Medicine at San Francisco.

WILBUR B. RAYTON, director of the Bausch and Lomb Optical Company, Rochester, N. Y., received a doctorate of science from Syracuse University on June 8.

DR. WILLIS A. GIBBONS, director of the general development department of the United States Rubber Company, has been awarded the honorary degree of doctor of science by Wesleyan University.

AMONG honorary degrees conferred on June 15 by the Ohio State University was the doctorate of science on Dr. Edwin G. Hastings, professor of agricultural bacteriology at the University of Wisconsin. Dr. Herbert B. Brooks, consulting electrical engineer, Washington, was presented with the Benjamin G. Lamme Meritorious Achievement Medal awarded each year to an alumnus distinguished in engineering.

THE Francis P. Garvan Gold Medal honoring women in chemistry has been awarded by the American Chemical Society to Dr. Florence B. Seibert, associate professor of biochemistry at the Henry Phipps Institute of the University of Pennsylvania, for "distinguished work on the chemistry of tuberculosis." The presentation will be made at the one hundred and fourth national meeting, to be held in Buffalo from September 7 to 11. The Garvan Medal was founded by the late Francis P. Garvan, of New York, president of the Chemical Foundation.

LEWIS H. CARRIS, director emeritus of the National Society for the Prevention of Blindness, has been awarded the Leslie Dana Gold Medal for outstanding achievements in the prevention of blindness and the conservation of vision. The medal is given annually through the St. Louis Society for the Blind by Leslie Dana, of St. Louis, on the recommendation of the Association for Research in Ophthalmology.

DR. JOSEPH MCFARLAND, emeritus professor of pathology of the University of Pennsylvania School of Medicine, was presented on May 7 with the 1941 Strittmatter Award of the Philadelphia County Medical Society. The award, which consists of a scroll describing the accomplishments of the recipient and a gold medal, was presented by Dr. Jacob Parsons Schaeffer, chairman of the committee on the award. Dr. William Wayne Babcock, professor of surgery at the Temple University School of Medicine, delivered the annual DaCosta Oration. He spoke on "The Life of a Surgeon."

DR. ERNEST SACHS, of St. Louis, was elected president of the American Neurological Association at the meeting of the society held in Chicago on June 4, 5 and 6.

THE annual meeting ending the 1941–42 season of the Physical Society of Pittsburgh was held on June 4 in the auditorium of the Mellon Institute of Industrial Research. Dr. Harold G. Moulton, president of the Brookings Institution, Washington, D. C., addressed the meeting on "Science and Government." Officers of the society elected for the 1942–43 term are: *President,* Professor Otto Stern, Carnegie Institute of Technology; *Vice-president,* Dr. Sigmund Hammer, Gulf Research and Development Company; *Secretary-Treasurer,* Dr. Lee Devol, Mellon Institute of Industrial Research.

DR. ROBERT T. LEGGE, professor of hygiene at the University of California and chairman of the department, has retired with the title emeritus. He was connected with the university for a period of twenty-eight years.

IN appreciation of his thirty years of service to Cornell University and on the occasion of his impending retirement as professor of astronomy and geodesy and as chairman of the department of astronomy, the friends and associates of Professor S. L. Boothroyd tendered him a testimonial dinner on the evening

of May 21. Professor R. William Shaw has been appointed chairman of the department of astronomy and director of the Fuertes Observatory to succeed Professor Boothroyd. Dr. Donald MacRae, of Harvard College Observatory, has joined the staff at Cornell as an instructor in astronomy.

A BANQUET in honor of Dr. Thomas B. Hartzell, emeritus professor of dentistry of the University of Minnesota, was given in Minneapolis on June 16. Dr. Hartzell is a past-president of the American Dental Association.

DR. RENÉ JULES DUBOS, member of the Rockefeller Institute for Medical Research, has been appointed George Fabyan professor of comparative pathology and professor of tropical medicine at the Harvard Medical School, Boston. He succeeds Dr. Ernest E. Tyzzer, who becomes professor emeritus.

DR. EUGENE A. STEAD, JR., instructor in medicine, Harvard Medical School, has been appointed head of the department of internal medicine at the School of Medicine of Emory University, Atlanta.

MALCOLM J. PROUDFOOT, assistant geographer of the Bureau of the Census, has been appointed assistant to the director of the bureau. Prior to his connection with the Census he was associate geographer of the Tennessee Valley Authority.

DR. WALTER E. HAMBOURGER has resigned his position as assistant professor of pharmacology at Western Reserve University, to become pharmacologist for G. D. Searle and Company, Skokie, Ill.

DR. HENRY WIGDERSON, formerly of New York University College of Medicine, was recently appointed neuro-surgeon in chief of the Rothschild Hadassah University Hospital, Jerusalem.

DR. MARSTON TAYLOR BOGERT, emeritus professor of organic chemistry of Columbia University, addressed a group of officers and committee members of the New York Academy of Medicine on May 20. He spoke on "Malaria and Quinine," illustrating his remarks by lantern slides depicting the cinchona industry of Java, plasmodia infecting humans and anopheline vectors.

A DEPARTMENT of Aeronautical Engineering has been established at Iowa State College, with Professor Wilbur C. Nelson as its head. In addition to training in aeronautical engineering and cooperation with the federal government in the civilian pilot training course, there will be research in aerodynamics, airplane structure and airplane engines. Courses in aeronautical engineering were formerly given in the department of mechanical engineering.

THE sixth annual Botanical Garden and Arboretum Day Program was held in the Botanical Garden of Huntington College, Indiana, on June 1. The address was given by Dr. Ralph Cleland, head of the department of botany of Indiana University. He reported his experiences of a botanical study in Jemaca. The Botanical Garden of Huntington College is now seven years old and has over 650 species of wild plants, including trees and shrubs collected mostly from Indiana and Michigan. The arboretum covers about forty acres of varied topography on which there are 35 mature species of trees and thirty of shrubs growing naturally besides many species of herbaceous plants. Over thirty trees and sixty additional shrubs have been brought into the arboretum and garden since its founding. This garden and arboretum are proving a valuable adjunct to the biology department of the college and are always open to visitors.

THE regular annual meeting of the trustees of the Elizabeth Thompson Science Fund was held on April 10. The following grants were awarded: Grant No. 366, $150 to Dr. Clinton M. Osborn, the Ohio State University, for equipment to build a constant temperature bath to be used in studies in the physiology and chemistry of pigmentation; and Grant No. 367, $250 to Dr. Benjamin Kropp, Queen's University, Canada, to be used for technical assistance in an experimental study of the cytology and growth of trophoblast.

THE Joint Committee on Indexing and Abstracting in the Major Fields of Research is formulating a plan for the study and solution of the most pressing problems connected with the publication of indexing and abstracting services covering the literature of the several scientific, humanistic, social science, learned, professional and business fields. The committee is composed of representatives from the following associations: The American Association of Law Libraries, The American Library Association, The American Medical Association, The Association of Research Libraries, The Medical Library Association, The National Research Council and The Special Libraries Association. The committee is interested in hearing from other associations or individuals interested in these problems. Address all communications to Mrs. Barbara Cowles, chairman, Joint Committee on Indexing and Abstracting in the Major Fields of Research, University of California Library, Berkeley, Calif.

A NEW American Standard known as "Definitions of Electrical Terms, C42," sponsored by the American Institute of Electrical Engineers, is now ready for general distribution. It is the first time the definitions of the important terms common to all branches

of the art as well as those specifically related to each of the various branches have been assembled and printed under one cover. This glossary is the result of more than twelve years' work of a sectional committee of 46 members having 18 subcommittees drawn from available specialists. More than 300 individuals have given material assistance and many others have assisted in specific instances. The thirty-four organizations represented on the sectional committee include the national engineering, scientific and professional societies, trade associations, government departments and miscellaneous groups.

AN extensive list of institutions, societies and research workers in the pure and applied plant sciences in Central and South America has been prepared by the editors of *Chronica Botanica,* in cooperation with the Division of Agriculture of the Office of the Coordinator of Inter-American Affairs, Washington. It has been published in *Chronica Botanica,* Vol. 7, Nos. 2 and 3 (March and May, 1942).

DRIVEN out of China by the advance of Japanese troops, the California College in China has come to the United States and is again functioning at the University of California at Berkeley. It is cooperating with the University Extension Division under the direction of President Robert Gordon Sproul and a faculty committee headed by Peter A. Boodberg, chairman of the department of Oriental languages. President W. B. Pettus, head of the Chinese college for the past twenty-five years, has lived in China more than thirty-five years. In Peiping the campus included fifteen buildings for classes, dormitories and a library. Much of the library, considered the finest library on China in the Orient, was rescued and is now in the collection of the University Library. Work at the university was made possible by grants from the Rockefeller Foundation and the Harvard-Yenching Institute. Among the trustees of the California College in China are President Sproul, David P. Barrows, chairman of the department of political science of the University of California, and James K. Moffitt, regent of the university.

ACCORDING to the *Journal* of the American Dental Association, United China Relief received a cablegram late in April announcing the safe arrival in India of R. Gordon Agnew, Canadian missionary, well known in this country for his work on the bacterial and dietary aspects of dental caries. Dr. Agnew, who was returning to his post at West China Union University at Chengtu, Szechwan Province, near Chungking, took with him from the United States twenty-three cases of surgical and dental instruments, a third of which were consigned to the medical relief corps of the Chinese Red Cross, supported by United China Relief. The instruments, valued at $12,000, and originally consigned to Rangoon, will reach China from India by a road that can be traveled only by mules.

DISCUSSION

METHODS OF DETECTING MILD CASES OF VITAMIN A DEFICIENCY

IN 1939 Booher, Callison and Hewston[1] asserted that "impaired dark adaptation as measured with the visual adaptometer was the earliest definite ocular abnormality observed as a result of vitamin A deficiency" experimentally induced.

In 1941 Kruse,[2] reporting on the biomicroscopic detection of conjunctival manifestations of avitaminosis A, stated that ordinarily xerosis conjunctivae probably precedes night blindness and recommended the biomicroscopic examination as a simple, convenient, objective method of detecting avitaminosis A.

Recently Miss Callison,[3] calling attention to the seeming discrepancy between the two sets of observations, argues that dysadaptation precedes conjunctival changes; indicates tacitly that the test for adaptation is the more reliable and preferred routine procedure for detecting avitaminosis A; and casts doubt on the reliability of the biomicroscopic method for that purpose.

Miss Callison's assertion that slit-lamp examination by ophthalmologists before and during impaired adaptation in her subjects and after their recovery revealed no evidence of abnormality in the conjunctivae carries the implication that they had consciously been looking for the conjunctival changes described by Kruse as characteristic of avitaminosis A. But they made their observations in 1938. And Kruse did not publish his description until 1941. It is not to be expected that they would recognize or regard changes as abnormal which in 1938 were generally accepted as normal or unrelated to avitaminosis A and which only since have been shown to be pathological and characteristic of avitaminosis A.

Indeed, if they were judging by keratinization of epithelium, as stated in their original report, it is

[1] L. E. Booher, E. C. Callison and E. M. Hewston, *Journal of Nutrition,* 17: 317, 1939.
[2] H. D. Kruse, *The Milbank Memorial Fund Quarterly,* 19: 207, 1941.
[3] E. C. Callison, SCIENCE, 95: 250, 1942.

clear that they were not diagnosing by the criteria later described by me. Nowhere in my paper is keratinization mentioned as an essential diagnostic criterion. Rather, certain definite changes of the conjunctiva were shown to be characteristic of avitaminosis A. Certainly then the biomicroscopic examinations reported in Callison's papers do not warrant the conclusions that night blindness was present in her subjects without conjunctival changes and that the biomicroscopic method is not a reliable method of detecting mild avitaminosis A.

Miss Callison raises the issue whether applying a method during the production of an uncomplicated experimental avitaminosis or during the specific treatment of the naturally occurring avitaminosis is the better test of its reliability. Either is acceptable, particularly with the support of collateral evidence. But beyond this, if a method is to be used routinely in detecting mild cases of avitaminosis, it must be applicable to the diversified natural conditions encountered in surveys of population groups.

In three surveys, routine examination for dysadaptation has failed completely to detect mild or early avitaminosis A. The data on the prevalence of avitaminosis A yielded by the method are entirely at variance with the results from diet studies, published by the Bureau of Home Economics. Furthermore, many cases of seeming dysadaptation have been found to have no basis in avitaminosis A.

In contrast, in more than one hundred individuals showing no impaired adaptation, gross or microscopic changes were present in the conjunctivae and slowly disappeared under administration of vitamin A. This evidence supports the conclusions that under ordinary conditions conjunctival changes probably precede dysadaptation in avitaminosis A and that examination of the conjunctivae is a reliable method of detecting avitaminosis A.

H. D. KRUSE

MILBANK MEMORIAL FUND

RUBBER ANALYSIS OF PLANTS IN SOUTH CAROLINA

IN 1930 and 1931 some plants growing in the vicinity of Clemson, South Carolina, were collected and analyzed for the presence of rubber. The plants were collected and identified by Mr. M. A. Rice, the chemical tests being made by the other two authors. The results are presented below. The figures given at the right show the percentage of rubber in each case. All determinations were made on a basis of air-dry weight.

Name of Plant	Per cent.
Ambrosia trifida L. Great ragweed	0.27
Amsonia Tabernaemontana Walt. Amsonia	0.26
Apocynum cannabinum L. Indian hemp	
No. 9: leaves	1.16
" 17:	0.73
Asclepias tuberosa L. Butterfly weed	
No. 5: stems	0.34
leaves	2.20
" 18:	2.21
" 22:	1.80
Asclepias sp. Milkweed	
No. 7: stems	0.38
leaves	1.93
" 10:	1.55
Asimina triloba Dunal. Papaw	0.54
Aster sp. Wild aster	1.03
Broussonetia papyrifera (L.) Vent. Paper mulberry	0.60
Cacalia atriplicifolia L. Pale Indian plantain	1.75
Decumaria barbara L. American decumaria	0.08
Erigeron annuus (L.) Pers. White-top	
Stems	0.09
Leaves	0.69
Eupatorium purpureum L. Joe-pye weed	0.45
Euphorbia corollata L. Flowering spurge	
Stems	0.26
Leaves	0.53
Euphorbia nutans Lag. Spotted spurge	0.26
Euphorbia sp. Spurge	0.70
Helianthus atrorubens L. Purple-disk sunflower	0.68
Lactuca sagittifolia Ell. Arrow-leaved lettuce	0.20
Lactuca Scariola L. Prickly lettuce	
No. 44	0.43
" 45	0.34
Lonicera japonica Thunb. Japanese honeysuckle	0.50
Morus rubra L. Red mulberry	1.02
Oxydendrum arboreum (L.) DC. Sourwood	0.24
Parthenium integrifolium L. American fever-few	1.05
Passiflora incarnata L. Maypop	0.25
Pyrrhopappus carolinianus (Walt.) DC. False dandelion	
No. 1: whole plant	0.51
" 2: stems	0.45
leaves	0.60
roots	0.61
Rhus glabra L. Smooth sumach	
Stems	0.38
Leaves	0.30
Robinia hispida L. Rose acacia	
Stems	0.29
Leaves	0.44
Sambucus canadensis L. Common elder	1.27
Silphium compositum Michx. Rosin-weed	0.74
Smilax sp. Greenbrier. (Material from a correspondent)	
No. 39: flesh of berries	1.85
" 41: flesh of berries	3.65
" 42: flesh of berries	2.05
Solidago spp. Goldenrod	
No. 3: stems	0.12
leaves	0.69
" 12: whole plant	0.89

" 23:	1.33
" 24:	1.45
Tephrosia virginiana (L.) Pers. Cat-gut	0.23
Verbesina occidentalis (L.) Walt. Small yellow crownbeard	1.22
Vinca minor L. Periwinkle	0.97
Vincetoxicum carolinense (Jacq.) Britton. Vincetoxicum	2.09

J. H. MITCHELL
M. A. RICE[1]
D. B. RODERICK

CLEMSON AGRICULTURAL COLLEGE,
CLEMSON, S. C.

OCCURRENCE OF VITAMINS IN FUNGI

IN reviewing the occurrence of vitamin B_2—riboflavin—Stark and others[1] mentioned that Wellstadt extracted riboflavin from *Lactarius deliciosus,* a common edible mushroom in 1935.

In 1940 a paper was published by the Academy of Science of the U.S.S.R. by G. S. Kitavin,[2] who reported that he obtained riboflavin by poisoning four-day cultures of *Aspergillus niger* grown on standard liquid media. He postulated that the mercury bichloride used as a poison resulted in physiological disturbance in the fungus which caused it to synthesize riboflavin. The riboflavin was adsorbed on a lead sulfide precipitate from which it was removed by washing with hot water. This eluant was concentrated and the solution was compared with standard solutions of riboflavin for color and fluorescence under the ultra-violet light. Crystalline riboflavin was extracted from his solutions.

Following this technique, the writers found that not only riboflavin—vitamin B_2—is produced by *Aspergillus niger,* but also thiamin—vitamin B_1. In addition to color and fluorescence tests, we used a Coleman photofluorometer which gives quantitative as well as qualitative tests. We have found in addition to *Aspergillus niger,* that other species of the higher fungi also produce thiamin and riboflavin, among which are the common market mushroom, *Agaricus campestrus, Pezzia badia,* a fleshy Ascomycete, certain species of the Glaucus group of Aspergillus, certain species of Penicillium and some of the Fusaria.

We also find that it is not necessary to add mercuric salts or other poisons to our cultures to produce vitamins, and we are able to obtain definite tests from both fungus mats or felts and media in which the fungi grow from cultures not poisoned.

From investigations carried on to date from diverse classes of fungi, it is quite evident that the production of thiamin, B_1, and riboflavin, B_2, and we suspect others, is a normal function of that group of plants known as fungi.

C. C. CARPENTER
E. W. FRIEDLANDER

DEPARTMENT OF PLANT SCIENCE,
SYRACUSE UNIVERSITY

[1] M. A. Rice is now at Ithaca, N. Y.

[1] I. E. Stark, E. S. Gordon and W. B. Christensen, "Respiratory Enzymes," by the University of Wisconsin Biochemists, 1939, chapter 4, pp. 105.

[2] G. S. Kitavin, Plant Physiology Laboratory, Leningrad University, Academy of Science U.S.S.R., 1940, Vol. XXVIII, No. 6.

RELEASE OF POTASSIUM BY THE BRAIN OF THE DOG DURING ELECTRICAL STIMULATION

THE application of electrical tetanizing stimulus in the nerves of the leg of the *Limulus polyphemus* produces a liberation of potassium according to Cowan[1] and Young.[2] Vogt[3] has shown that a long excitation of the preganglionic cervical fibers of the dog produces a reduction of potassium in the corresponding ganglions.

In experimental epilepsy, obtained by electrical excitation of the dog's brain, Zagami[4] has found an increase of the plasma potassium and in his clinical observation, Mac Quarrie[5] has reached the same conclusion. But in both cases there are generalized muscular contractions which are probably the determinative cause of the increase of potassium. Ernst and Scheffer[6] have shown this liberation of potassium in the voluntary muscles and Cicardo[7] in the involuntary muscles.

Considering that the liberation of the potassium ions might have some relation or may be the determinative cause of the negative electropotential which originates in any tissue in activity, we assumed that a similar liberation of potassium might take place in the brain during its excitation with electrical stimulation.

In our experiments, electrical excitation of the brain of spinal or curarized dogs, in which there are no general contractions, produces an increase of potassium in the blood of the superior longitudinal venous sinus. This increase of plasma potassium is not accompanied by a similar increase of potassium in the blood simultaneously drawn from the femoral artery; which allows us to establish the cerebral origin of the liberated potassium.

V. H. CICARDO
A. TORINO

DEPARTAMENTO NACIONAL DE HIGIENE,
INSTITUTO BACTERIOLÓGICO,
BUENOS AIRES, ARGENTINA

[1] S. L. Cowan, *Proc. Roy. Soc.,* B 115: 216, 1934.
[2] A. C. Young, *Jour. Neurophysiol.,* 1: 4, 1938.
[3] M. Vogt, *Jour. Physiol.,* 86: 258, 1936.
[4] V. Zagami, *Arch. Sc. Biol.,* 11: 301, 1928.
[5] Mac Quarrie, *Jour. Ann. Int. Med.,* 6: 497, 1932.
[6] E. Ernst and L. Scheffer, *Pflügers. Arch. ges. Physiol.,* 220: 655, 1928.
[7] V. H. Cicardo, *Rev. Soc. Arg. Biol.,* 17: 81, 1941.

A CENTURY OF DARWINISM

LEST preoccupation with discordant matters of our day permit it to pass unnoticed, I venture to say that the month of June marks the one hundredth anniversary of Darwin's writing the first draft of the "Origin of Species." Referring to it in his autobiography he says, "In June 1842 I first allowed myself the satisfaction of writing a very brief abstract of my theory in pencil in 35 pages; and this was enlarged during the summer of 1844 into one of 230 pages, which I had fairly copied out and still possess." Darwin's son, who assumed responsibility for the publication of these two manuscripts, says, "It only came to light after my mother's death in 1896 when the house at Down was vacated. The Ms. was hidden in a cupboard under the stairs which was not used for papers of any value, but rather was an overflow for matters which he did not wish to destroy." These forerunners are indispensable to biologists who are interested in Darwin's views of evolutionary processes about a decade and a half before they were made accessible to his contemporaries through publication of the "Origin of Species by Means of Natural Selection" (1859). These manuscripts were first published in 1909 by his son, Francis Darwin, under the title "The Foundations of the Origin of Species" (Cambridge: University Press).

CALVIN P. STONE
STANFORD UNIVERSITY

QUOTATION

MR. McNUTT AND THE DOCTORS

THIS year's meeting of the American Medical Association is of extraordinary importance, since the time has come to take stock of our medical resources and to consider how they can be most effectively distributed to meet the needs created by the war. Paul V. McNutt appeared twice before the meeting to express the Government's dissatisfaction with what has been done thus far. As yet, neither the Government nor organized medicine has presented an adequate plan to meet our medical emergency. No program has been submitted to satisfy both the Army and the civilian population. Mr. McNutt threatened action by the Government if more aid is not forthcoming. His charge that only one third as many physicians volunteered in the first six months of this war as in the corresponding period of the last war indicates that not even the Army has been supplied with all the doctors it must have.

If we are to have an Army of 9,000,000 men, as Mr. McNutt suggested, the armed forces will need one third of all our physicians, including those who have retired. What is to become of the civilian population, especially where villages of a few hundred have mushroomed in a few months into communities of fifty and seventy thousand? To leave that problem to local practitioners is clearly no solution. "Doctors will have to be assigned on a voluntary or on some other basis," warned Mr. McNutt. We shall have to establish Federal medical facilities and experiment with new forms of medical practice. Lastly, there is the problem of rehabilitating the wounded and crippled veterans of this war—men to whom the nation owes a heavy debt. Here we face the task not only of restoring the handicapped to something like good physical condition but of training them for industrial tasks that they can perform.

Medicine, as Mr. McNutt rightly reminded his audience, is presented with an extraordinary opportunity. It is plain enough that doctors must not only rise to a critical occasion but that they must willingly engage in a social experiment which will clearly indicate what kind of medicine we must have if we are to carry out the implications of the Social Security Act.—*The New York Times.*

MORE ANTISEPTICS FROM MOLDS

THE fact that some microorganisms produce antiseptic substances—acting, of course, only on other unrelated species—has recently advanced from the sphere of purely academic interest towards that of practical application. The best known of these substances, penicillin, has been put on the therapeutic map by the work of Florey and his colleagues to which we referred last year, although difficulties of production still bar the way to extensive clinical trial. For some years past Dubos and others have been studying the antibacterial substances which can be extracted from cultures of *B. brevis:* one of these, now known as "gramicidin," has been shown to exert its action *in vivo*. Another example is actinomycin, isolated by S. A. Waksman and H. B. Woodruff from a streptothrix which they have named *Actinomyces antibioticus*. All these microorganisms have been identified either by chance or by selective breeding out from material containing an unknown and complex flora. As two of them are fungi it might well be worth while to study related species systematically with the object of finding others behaving similarly. This task has in fact been undertaken by H. Raistrick and his colleagues, and the work has been in progress for some years, in the course of which no fewer than

fifty products have been isolated from cultures of many more different moulds: they appear to be relatively simple compounds, for the molecular structure of many of them has been established, and in some cases they have also been synthesized. Raistrick and others have now described the isolation and properties of two of these compounds. Citrinin is formed by *Penicillium citrinum,* and penicillic acid—a quite different substance from penicillin—was first detected many years ago in *Penicillium puberulum,* found in mouldy maize, but has been obtained for this work in larger quantities from *Penicillium cyclopium.* When a suitable culture medium is used the yield of these substances is as large as 2 grammes per liter, and the processes of extraction and purification are simple; it appears also that the resulting products are stable. The investigation of citrinin and penicillic acid for biological activity has so far only reached the stage of simple *in vitro* tests of power to inhibit bacterial growth in broth. This power is possessed by both to a degree which ranks them below penicillin in activity against certain bacteria, a degree, nevertheless, which ought to be effective therapeutically should their application prove feasible. Citrinin acts almost exclusively on Gram-positive species; penicillic acid has also the power to inhibit the growth of the Gram-negative intestinal bacteria.

It was shown by Florey and his colleagues in various ways that penicillin exerts its bacteriostatic action not only in plain broth but in the presence of high concentrations of serum protein. Whether this is also true of citrinin and penicillic acid remains to be seen; from their similar derivation and behavior an affirmative answer is to be expected. It is an even more important point in favor of penicillin that it can be shown in many ways to be singularly harmless to the living cells of the body; this is another character which awaits investigation in these two new compounds, and unfortunately it is not one which can confidently be predicted, because some antiseptics of microbic origin are highly toxic. Raistrick and his colleagues are careful to point out that until the necessary biological tests have been made it should not be concluded that citrinin and penicillic acid will take their places as chemotherapeutic agents. They emphasize, nevertheless, that if such tests should prove favorable these compounds have an immense advantage over penicillin in that their large-scale production would be a comparatively simple matter. Their yield per liter of medium is actually two hundred times greater, and extraction is by a simple process. It is also noteworthy that their molecular structure is known, and although neither has yet been synthesized a study of the biological properties of related synthetic compounds might well yield interesting results.—*The British Medical Journal,* March 14, 1942.

SCIENTIFIC BOOKS

CHEMISTRY

This Chemical Age. By WILLIAM HAYNES. xxxii + 385 pp. Illustrated. New York: Alfred A. Knopf. 1942. $3.50.

THIS is a fascinating historical narrative of the miracle of man-made materials, by an author whose previous writings of this nature are well known. Sixteen full-page plates in stunning colors immediately set the layman in a receptive mood for this family album of familiar faces, of facts and figures, of historical anecdotes and of bits of characterizations.

The story of dyes (three chapters) starts with Perkin and leads through synthetic mauve, alizarin and indigo to the breaking of the great German Dye Trust and the birth of industrial organic chemistry in America.

Drugs (two chapters) relate the stories of quinine and of salvarsan, with an especially up-to-date family history of sulfanilamide in which we see Domagk and the I.G., Colebrook in London, and Long and Crossley in America.

Rubber (three chapters) shows Macintosh and his cheap solvent for rubber, Goodyear's vulcanization process, Oenslager's compounding of rubber, closing with a résumé of modern rubber substitutes, neoprene, Thiokol and butadiene rubbers.

Petroleum (one chapter) flows from Titusville to iso-octane; but Houdry and alkalation are too young to be included in the album.

Textile fibers (three chapters) stretch from Chardonnet rayon to Carothers' nylon polymers and include lanital and Aralac from milk.

Plastics begin with Hyatt's celluloid and end in the next chapter with Bakelite. Unfortunately, the newer polymerization plastics, such as the methacrylates, are scarcely mentioned. Separate chapters review the history and chemistry of perfumes, the Hercules Powder Company's program for naval stores and Creighton's electrolytic processes.

A final interesting chapter on "Our Chemical Armory"—potash, nitrogenous explosives, chemical war gases and incendiary bombs—is included for enthusiastic air-raid wardens.

A simple glossary and a splendid index conclude the book.

The freely flowing narrative is marred, at times, by inaccuracies of the most elementary chemistry—for instance, phosphorus is classed as a metal on page

368—but it is to be hoped that a reprinting will rectify these minor errors so that these well-told tales, and they are indeed well-told, of the rise of chemical industry may be passed on to the young people of America, and not lose scientific accuracy in their telling.

H. N. ALYEA

PRINCETON UNIVERSITY

Organic Chemistry (with applications to pharamacy and medicine). By ELDIN V. LYNN.

AN elementary text-book of organic chemistry. The treatment of the major classes is conventional and adequate for an elementary text. At the end of each chapter dealing with group properties reference is made to the properties and the uses of the more important medicinals and pharmaceuticals falling in that group. When important medicinals fall into a subordinate class they are placed in one of the major classes for discussion. Thus the chapter on aromatic acids contains references to alypin, saccharin, halazone, butesin, procaine, mandelic acid. The treatment of the major groups is adequate for an elementary text, but the treatment of the more complex groups—the sterols, heterocycles, alkaloids, dyes, etc.—becomes heavily weighted with a description of chemicals and very lightly weighted with group properties. The text should be of interest to colleges of pharmacy and teachers of premedical students. Review questions follow each chapter. The format and style are both very good.

GARFIELD POWELL

SOCIETIES AND MEETINGS

THE KANSAS ACADEMY OF SCIENCE

THE seventy-fourth annual meeting of the Kansas Academy of Science was held at Hays, Kansas, on March 26, 27 and 28, with Dr. F. C. Gates, Kansas State College, Manhattan, Kansas, presiding. The following other state societies held their meetings in cooperation with the academy: The Kansas Association of Teachers of Mathematics, the Kansas chapter of the Mathematical Association of America and the Kansas chapter of the American Association of University Professors. The Kansas Entomological Society, which is affiliated with the academy, held its eighteenth annual meeting on April 4, in Lincoln, Nebraska. The Weather-Crops Seminar, another affiliated society, held its meeting at Lawrence on December 6, 1941.

The academy program opened on Thursday evening with an illustrated lecture by Dr. A. C. Kinsey, of Indiana University, on "Bug Hunting in Mexico."

Section meetings were held during Friday by Botany, Chemistry, Geology, Junior Academy, Physics, Psychology and Zoology as well as a special program at 11 A.M., at which Dr. A. C. Kinsey, of Indiana University, presented a special paper entitled "Studies in Human Behavior." The Biology Teachers and the College Students held their section meetings on Saturday morning.

At the annual banquet on Friday evening, President Elect R. H. Wheeler presided as toastmaster. The address of welcome was given by Dr. L. D. Wooster, president of Fort Hays Kansas State College, and dealt with the challenge of the hour to science. Several of the older life members were present and they were introduced to the group.

Mrs. Otilla Reagan, donor of the Albert B. Reagan memorial fund, attended the meeting and spoke briefly of some pamphlets on the life and work of Dr. Reagan which she has for distribution.

The banquet was followed by the annual public meeting. The address for this meeting was the presidential address given by President Gates. He used as his subject "Plant Succession," accompanying the discussion with lantern slides, not only illustrating plant successions in various parts of the world but also exhibiting some economic applications involving the principles of succession.

The Saturday morning program consisted of a business meeting and a geological field trip to the Fossil Chalk Beds. At the business meeting Professor Agrelius, of Kansas State Teachers College, Emporia, reported the death of the following members: Malcolm J. Brumwell; Ellsworth Brownell Knerr, M.D.; Dr. Ulysses Grant Mitchell, Dr. Clarence Edmund Rarick and Dr. John Eric Welin. Dr. W. H. Mikesell, of the University of Wichita, chairman of the committee on educational trends, gave a report of an extended study of the psychology course as given in the high schools in the state, together with a statement of the type of textbook desired by high-school teachers of psychology. The winners of the awards in the Junior Academy meeting were announced by Dr. L. D. Wooster. Ernest Sellers and Dorothy Krey, both of Manhattan, were awarded the honorary junior memberships in the American Association for the Advancement of Science for the coming year.

The academy registration was 225. In addition, the Junior Academy had a registration of 60; the Kansas Entomological Society 45; the Mathematical Societies 75; and the University Professors 35.

The reports from the section chairmen on their sections is presented herewith in Table 1.

It was decided that a section for college students

is to be made a permanent feature of the academy. This section will be managed by an academy committee to insure continuity.

The next annual meeting of the academy and the cooperating societies will be held at Lawrence, Kansas. This will be the seventy-fifth annual meeting and plans are being formulated for a suitable celebration.

The following officers were elected for the next year and meeting: *President,* R. H. Wheeler, University of Kansas; *President-elect,* H. A. Zinszer, Fort Hays Kansas State College; *Vice-president,* L. D. Bushnell, Kansas State College; *Secretary,* John C. Frazier, Kansas State College; *Treasurer,* F. W. Albertson, Fort Hays Kansas State College.

Executive council members are F. C. Gates, Kansas State College; John W. Breukelman, Kansas State Teachers College, Emporia; and J. A. Trent, Kansas State Teachers College, Pittsburg. Two associate editors, chosen for three years, are A. B. Cardwell and Mary T. Harmon, both of Kansas State College.

Dr. Robert Taft, of the University of Kansas, is the editor of the *Transactions,* now in its 45th volume, and Dr. Roger C. Smith, of Kansas State College, will serve the third year of his three-year appointment as representative to the academy conference.

TABLE 1
Section Record, with Past and Future Officers—Hays Meeting

Name of Section	Chairman, 1942	No. papers on program	No. persons attending	Chairman for 1943
Biology Teachers	R. L. Tweedy	4	37	Sherwin B. Griswold
Botany	S. M. Pady	23	50	Andrew Riegel
Chemistry	L. C. Kreider	10	55	Wilbert Chappell
College Students	E. O. Deere	4	25	E. O. Deere
Entomology (At Lincoln, Nebr., April 4)	Don B. Whelan	20	45	H. B. Hungerford
Geology	George M. Roberston	11	15	H. T. U. Smith
Junior Academy	John Michener, Jr.	15	60	Ernest Sellers
Junior Academy Committee	L. D. Wooster			Edith Beach
Physics	R. F. Miller	10	30	W. D. Bemmels
Psychology	H. E. Schrammel	14	44	O. W. Alm
Weather Crops (At Lawrence, Kans., Dec. 6, 1941)	R. H. Wheeler	6	150	H. H. Laude
Zoology	E. H. Herrick	16	30	Jacob Uhrich
Kans. Assoc. Teach. Math.	Kathleen O'Donnell	7	40	Daniel Pease
Math. Assoc. of America, Kansas Chapter	C. F. Lewis	7	35	C. F. Lewis
A. A. U. Professors	A. B. Sageser	5	35	E. O. Stene

A new standing committee dealing with science in public relations was set up, with Roger C. Smith as chairman. In addition a temporary committee dealing with the relation of the academy to the war was established under the chairmanship of Dr. L. C. Heckert, of Kansas State Teachers College, Pittsburg.

JOHN C. FRAZIER,
Secretary

MANHATTAN, KANSAS

REPORTS

FIELD MUSEUM OF NATURAL HISTORY[1]

DURING the past year I have been on active duty with the United States Army, serving at Sixth Corps Area Headquarters in Chicago. I desire to express my sincere appreciation to the Board of Trustees for permitting me to continue as director of the museum during this period. I further desire to record my gratitude to President Stanley Field, who by assuming many of the duties which normally fall to the director has made it possible for me to carry the remaining load in the evening hours and in the week-ends at my disposal.

The activities of the past year have been colored somewhat by anticipation of the impending war, which finally came to our country on December 7. Every effort was made at the museum to bring to a conclusion the many required tasks of maintenance and the many purchases of equipment which might be difficult to obtain due to the increasing restrictions brought about by so-called "defense priorities."

On June 30 the federal Work Projects Administration program at Field Museum was discontinued by governmental order to make available the full force of WPA assistance for other projects closely connected with the national defense efforts. The administration of Field Museum had long anticipated the discontinuance of this program, and the director had repeatedly warned the staff to bring as many special projects to a conclusion as possible. It was desired to avoid being caught with several unfinished projects on hand and no labor available. This course of action proved to be a wise one. Temporary provision was made for a very few unfinished items of business, as it was manifestly impossible to foresee accurately the exact month when discontinuance of WPA work would occur.

[1] From the annual report of the director, Dr. Clifford C. Gregg, to the Board of Trustees for the year 1941.

During the latter part of the year plans were made for operations on a greatly reduced scale, because the current and future enormous increases in taxation are almost certain to be felt in the way of reduced income for this institution. The competition for contributions, due to the needs of many worth-while war-time projects such as United Service Organizations, the Red Cross, and others, together with the proper desire of our citizens to purchase as large quantities as possible of government bonds for war purposes, is bound to be felt in the form of loss of income at the museum. It seems proper, then, to plan to operate on a reduced income, maintaining as far as is possible all of the many services available to the public in order that the influence of this institution may still be felt at a time when normal educational and cultural influences are most necessary. It is hoped, however, that members of the museum will appreciate the problems of this institution as well as its services to the public, and will therefore continue their support to the best of their ability. It is encouraging to note that despite the increasing demands made upon the public purse, the museum achieved a modest gain in memberships during 1941. There were 4,313 names of members on the rolls at December 31 as compared with 4,225 on the corresponding date of the previous year.

One of the major undertakings completed during the year was the relocation and reconstruction of the library so as to make it more easily available to the public. The opportunity was seized to install the finest type of indirect lighting available, and further, to build into the new library many of the features found to be helpful through an experience of twenty years in its former location. The space formerly occupied by the library has been converted into a stack-room, where provision has been made in advance to take care of the expected increases in space demands due to the additional books and pamphlets which are continually being acquired. It has also been possible to provide for the binding of many years' accumulation of periodicals, and for the rebinding of many fine volumes which had suffered from years of almost constant use.

Another outstanding improvement accomplished during 1941 was the reinstallation of the splendid collection of gems and jewelry in H. N. Higinbotham Hall (Hall 31). These beautiful and valuable precious and semi-precious stones had been displayed since 1894 in the original cases which contained them at the time of their acquisition. It is historically interesting to recall further that these cases housed the basic collection at the 1893 World's Columbian Exposition in Chicago. During the intervening years tremendous improvements have been made in case-building, room construction and lighting. The opening of the new hall late in June brought amazement to many who were quite familiar with the collections, for their great beauty had been so inadequately brought out in the former installation that a sharply striking and certainly most pleasing contrast was provided by the improvements now achieved. On the day of opening, a reception and tea were announced for the members of the museum, many of whom responded and were welcomed to the new Hall of Gems.

One of the most unusual exhibits in any museum of anthropology or natural history is that of the mummy Harwa, which was installed in the Hall of Egyptian Archeology (Hall J) in 1941 after being seen by millions at the New York World's Fair during 1939 and 1940. This mummy came to America in 1904 and has been a part of Field Museum's collection since that time. It was lent to the General Electric X-ray Corporation for the purpose of their special exhibit, due to the fact that this institution and that company had previously cooperated in experiments to perfect the technique of x-raying material of this type. At the close of the second year of the fair in New York, the General Electric X-ray Corporation, in appreciation, graciously presented the entire exhibit to Field Museum. I desire here to express publicly the sincere thanks of this institution for such a splendid gift. The exhibit has been placed in a special chamber in Hall J. There visitors may see Harwa first in his external mummy wrappings; then, automatically, a fluoroscopic screen moves in front of the mummy and an electric current of 125,000 volts activates x-rays which penetrate to Harwa's interior and project the image of his ancient skeleton on the screen. Lead glass protects visitors from being harmed by the rays. The x-ray and mechanical equipment were especially designed and built for this particular purpose, at a cost of many thousands of dollars. General Electric engineers and technicians assisted in the work of installing it at the museum. When visitors to the Egyptian Hall are few in number, they may themselves operate the exhibit by pushing a button. On days when there are many visitors, the cycle is repeated automatically at 40-second intervals throughout the day.

The opening in 1941 of the Hall of Fishes (Hall 0) on the ground floor completes a series of three splendid halls which are devoted to marine life. The Hall of Marine Mammals (Hall N) occupies a central position and contains habitat groups of seals, sea lions, manatee and narwhal. On the south side of this hall is the Hall of Lower Invertebrates (Hall M) which was announced in the annual report of the director for the year 1939. The new Hall of Fishes, which was opened in July, is adjacent to and directly

connected with the Hall of Marine Mammals. Habitat groups include one showing the fishes of the Bahama coral reefs, another showing the rocky coast of Maine, and one of the sandy ocean floor of the Texas coast. In addition, there is an extensive systematic collection of fishes in kindred forms running from the giant whale-shark down to the tiny frog-fish from the Sargasso Sea.

Throughout this report there are cited many instances of new exhibits which have been opened to the public. It is only natural that any reader would attribute full credit to the department sponsoring each exhibit. Little thought or appreciation is given to the Division of Maintenance or the Division of Engineering through whose efforts the painstaking details of case-planning, lighting, construction and even to a large extent the actual installation are carried out. I am pleased to call especial attention to the effectiveness, thoroughness and spirit of cooperation with which these divisions carry on their work.

There are many persons whose names are not found in the press reports or on the labels of the museum exhibits, who contribute valuable service without which the museum could not continue. I acknowledge a debt of gratitude to the many men and women who perform routine jobs with skill and extreme care, and who thus contribute to the maintenance of the good name of this institution.

SPECIAL ARTICLES

THE SEPARATION AND CHARACTERIZATION OF CAROTENOID PIGMENTS PRODUCED FROM MINERAL OIL BY BACTERIA[1]

DURING the course of research studies[2] on the utilization of petroleum products by microorganisms a culture of *Mycobacterium* was isolated which produced "oil-soluble" yellow and orange pigments when grown on a substrate composed of mineral salts and mineral oil.[3]

The identification of these pigments, which were subsequently found to be carotenoids, was complicated by the fact that they could not be removed from the oil by the conventional methods used in the analysis of plant tissues. Extraction methods employing various solvents were not successful because the pigments were either not removed or, if removed, were accompanied by some of the oil.

In the preliminary trials, the chromatographic adsorption technique used by Strain[4] in the separation of leaf xanthophylls was used with a mixture of 50 per cent. MgO (Micron Brand No. 2641), and 50 per cent. siliceous earth as the adsorbent; however, when saponified pigment-bearing oil was passed through the column, incomplete separation resulted. When an attempt was made to wash the column free from mineral oil by the use of petroleum ether (B. P. 30°–60°), the pigments migrated with the ether and oil mixture. However, a column of the MgO alone was found to retain the pigments very tenaciously in the upper one-fourth inch of the column. Repeated washings with petroleum ether failed to remove the pigments, but the oil was removed by this means.

Since the pigment fraction in all separations was confined to the extreme upper portion of the column and because the passage of the oil through the column was too slow, the orthodox type of adsorption tube used in chromatographic analysis was discarded for the preliminary separation of the pigments and oil. Instead, a Jena glass filtering crucible (capacity, 30 cc; height above disc, 45 mm; diameter of disc, 30 mm) of the Gooch type was used. This device, when packed with adsorbent, permitted a rapid separation of the pigment from the oil because of the increased surface area of the adsorbent. Complete separation of the pigments was effected from as much as 100 ml of oil by this technic.

The pigmented portion of this column was then removed mechanically, and the pigments eluted by petroleum ether containing a small amount of ethyl alcohol. Extraction of the petroleum phase with 90 per cent. methanol at this point showed xanthophylls to be absent. The pigment solution was then evaporated to dryness under vacuum. The semi-crystalline residue was redissolved in a minimum amount of petroleum ether (1.0 to 2.0 ml) and chromatographed on a column containing 50 per cent. MgO and 50 per cent. silicious earth. Three distinct pigmented bands were obtained in this manner.

The color of the successive bands from the lowest to highest were: (I) yellow, (II) orange and (III) pink. In addition to the above-described pigments, a red pigment (IV) appeared in the 90 per cent. alcoholic-KOH solution used in the saponification of the oil. This pigment exhibited all the chemical properties of astacin[5] and possessed a single absorption maximum at 5,000 Å in carbon disulfide.

[1] Contribution No. 213, Department of Bacteriology, and No. 273, Department of Chemistry.

[2] H. F. Haas, M. F. Yantzi and L. D. Bushnell, *Kansas Acad. Sci. Trans.*, 44: 39–45, 1941.

[3] Refined light mineral oil having a specific gravity of 0.84 at 25° C. and a viscosity of about 105 (saybolt) at 100° F.

[4] "Leaf Xanthophylls," H. H. Strain, Carnegie Institution of Washington, Pub. No. 490, 1938.

[5] G. Wald and H. Zussman, *Jour. Biol. Chem.*, 122: 449–460, 1937.

Pigments I, II and III had adsorption maxima similar to beta-carotene in petroleum ether. Biological assay by the U.S.P. XI procedure indicated that pigment II had vitamin A activity equivalent to that of beta-carotene, while pigment I had half the potency. Pigment III was completely devoid of vitamin A value.

These findings may be summarized as follows: (1) A new adsorption technic was developed for the separation of petroleum soluble carotenoids from mineral oil; (2) four carotenoids were separated as products of bacterial metabolism with mineral oil as the sole source of carbon; (3) two of these pigments possess vitamin A potency; (4) no xanthophylls were present; (5) one pigment was definitely shown to be astacin, a carotenoid found primarily in crustacea, and not hitherto associated with bacterial metabolism.

H. F. HAAS
L. D. BUSHNELL
W. J. PETERSON

KANSAS AGRICULTURAL EXPERIMENT STATION

SYNTHESIS OF ASCORBIC ACID IN EXCISED TOMATO ROOTS

ROOTS which have been carried through many passages in nutrient solution with no ascorbic acid supplied must either be able to grow without it or they must be able to synthesize it from the materials contained in the culture solution. Previous tests[1] conducted with excised roots of the white moonflower, grown in darkness for several weeks, had shown no more ascorbic acid than was present in the original explants. The cultures kept in light developed chloroplasts and contained 4 to 10 times the quantity of vitamin C present in the original explants. The results thus suggested that only the roots which contained chlorophyll had the capacity to synthesize ascorbic acid. In the light of more recent studies, however, it seems probable that synthesis occurred in the non-chlorophyllous roots, but that utilization of the product occurred also and at about the same rate as synthesis, resulting in the maintenance of a constant content per root.

A continuation of this type of study with non-chlorophyllous roots of another type was considered desirable. For this purpose cultures of tomato roots were prepared, using a modified Pfeffer's solution containing 1 per cent. cane sugar with 10 mμ moles of vitamin B_1 and 50 mμ moles of vitamin B_6 per flask. As inoculum, root segments were used which had grown for 60 passages during a period of 5 years in Pfeffer's solution + cane sugar + vitamin B_1. This procedure of long-continued culturing and numerous passages guarantees that the roots used as inoculum contained nothing other than that derived from the basal solution or synthesized by the roots in culture. The roots were grown in the culture solution 4 to 5 weeks, half of the cultures being kept in diffuse light and half in darkness. Ascorbic acid determinations were made by the indophenol method. Table 1 presents the results of these experiments.

TABLE 1

ASCORBIC ACID CONTENTS OF EXCISED TOMATO ROOTS

No. of expt.	No. of roots	cc of indicator required	Green weight per root (g)	Ascorbic acid	
				mg/root	mg/gram
			Light		
1	35	1.36	0.076	.0033	.043
2	30	1.41	0.192	.0055	.029
			Darkness		
1	35	0.48	0.069	.0010	.014
2	30	1.50	0.155	.0058	.037

A definite indophenol-reducing action of the root extracts was observed and with approximately the same speed of reaction as occurs with vitamin C. Moreover, the reaction was of such magnitude as to eliminate the possibility of transference of the total quantity of the reducing substance from the original explants. The reducing activity per root of cultures kept in the light in the second test was considerably higher than that of similar cultures in the first test but lower on a per gram basis. The weight per root was more than twice that of the roots in the first test. The reason for the higher reducing action per root of the cultures kept in darkness in the second test as compared to that in the first is not clear but it may be in part the effect of the slightly higher temperature at which the second set of cultures were kept. The weight of the roots increased from 70 to 200 fold during the culture period. Presumably the ascorbic acid increased in approximately the same proportion.

These results indicate fairly definitely that sterile cultures of excised tomato roots kept either in darkness or in light have the capacity to utilize sucrose in the synthesis of ascorbic acid, but a final conclusion on the effect of light on the synthesis of vitamin C by excised roots is not possible from these experiments. It is probable that intact plants have the ability to synthesize vitamin C at night by utilizing some of the stored carbohydrates. However,[2, 3, 4, 5] not only has no gain in absolute amount of ascorbic

[1] M. E. Reid and R. L. Weintraub, SCIENCE, 89: 587–8, 1939.

[2] E. F. Kohman and D. R. Porter, SCIENCE, 92: 561, 1940.

[3] H. G. Moldtmann, *Planta*, 30: 297–342, 1939.

[4] A. M. Smith and J. Gillies, *Biochem. Jour.*, 34: 1312–1320, 1940.

[5] M. E. Reid, *Am. Jour. Bot.*, 27: 18.S., 1940.

acid per plant been found to occur at night, but instead, losses of 15 to 20 per cent. have been observed. It is thus evident that neither the total gain nor loss at night can be estimated by the methods which have been employed and that the total losses are probably considerably greater than have been estimated. The results thus suggest that vitamin C may play a much more important part in the economy of the plant than has been previously attributed to it.

MARY E. REID
NATIONAL INSTITUTE OF HEALTH,
U. S. PUBLIC HEALTH SERVICE
WILLIAM J. ROBBINS
NEW YORK BOTANICAL GARDEN AND
DEPARTMENT OF BOTANY,
COLUMBIA UNIVERSITY

SCIENTIFIC APPARATUS AND LABORATORY METHODS

AN APPARATUS FOR VACUUM DRYING IN THE FROZEN STATE[1]

IN the fractionation of thermo-labile biological products it often becomes necessary to recover small amounts of solids from comparatively large volumes of solution. Vacuum drying in the frozen state, as recommended by Flosdorf and Mudd[2] and Link, Eggers and Moulton,[3] is often preferred, particularly if the material is protein in nature.

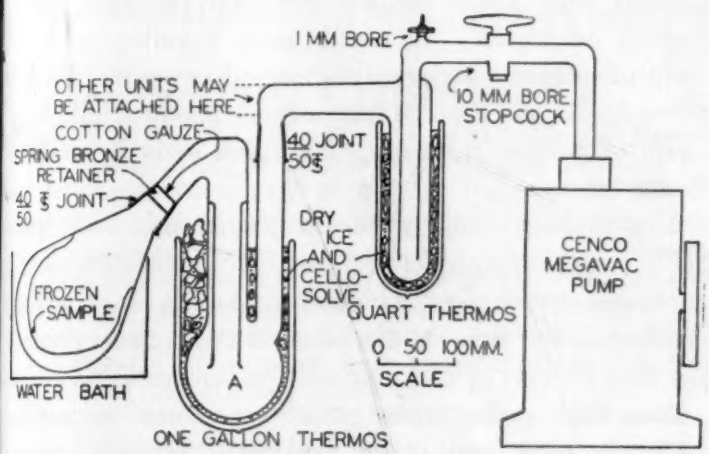

FIG. 1

The apparatus shown in the diagram is designed so that each receiver (A) is capable of receiving 500 to 600 cc of the distillate within a period of twelve hours. A Cenco Megavac pump serves to create the vacuum. A mercury vapor diffusion pump is not necessary. The water bath surrounding the flask containing the sample is left at room temperature and serves to prevent ice formation on this flask during evaporation. An acetone bath chilled by solid carbon dioxide is used to freeze the sample to be evaporated, while methyl cellosolve is used in place of acetone in the vacuum bottles in order to minimize loss through evaporation. A short spring bronze cylinder is used to hold a piece of cotton gauze in the neck of the sample flask to prevent loss of dry particles due to rapid vapor currents.

The apparatus is constructed of pyrex glass, is simple, compact and sturdy and has become nearly indispensable in our laboratory. It has been used to recover biologically active materials from as much as one liter of solution in a period of twenty-four hours with a single change of the receiver and recharging with solid carbon dioxide after twelve hours. Solutions containing the gonadotropic or thyrotropic fractions from the pituitary, choline esterase, bacterial toxins, whole blood, minced tissues and various extracts have been shown to retain their solubility and biological activity under such treatment. Solutions treated with toluene according to the method of Railton, Cunningham and Kirk[3] yield sterile preparations.

EDWIN E. HAYS
F. C. KOCH
DEPARTMENT OF BIOCHEMISTRY,
UNIVERSITY OF CHICAGO

[1] This work was supported in part by a grant from Armour and Co.

[2] E. W. Flosdorf and S. Mudd, *Jour. Immunol.*, 29: 389, 1935.

[3] G. K. K. Link, V. Eggers and J. E. Moulton, *Bot. Gaz.*, 102: 590, 1941.

ELIMINATION OF DEHYDRATION IN HISTOLOGICAL TECHNIQUE

THE classical methods for preparing tissues for microscopic study have a number of disadvantages. One of the more important is the extensive dehydration of the specimen by passage through increasing concentrations of alcohol. Another, consequent upon this, is the solution of cellular fat in the alcohol; this requires, for fat stains, the setting aside of special blocks of tissue and the use of the frozen section technique.

In the search for an improved method which would avoid dehydration, we thought of the recently synthesized group of resins, the polyvinyl alcohols, more familiar in the trade as PVA. These substances are readily soluble or dispersible in water, forming sols which penetrate easily into tissues. They can be made to form gels of a consistence comparable with that of celloidin. Sections may be cut as thin as four to five micra without difficulty. These stain excellently with hematoxylin-eosin, Masson's trichrome, Weigert-van Gieson; staining for fat is done with Sudan III on sections cut from the same block. The polyvinyl alcohols in solution are considered stable to the action of bacteria and most fungi; in our tests, the gels as well

[3] I. R. Railton, B. Cunningham and P. L. Kirk, SCIENCE, 94: 469, 1941.

allowed no such growth. Finally, the cost of the entire process is well within the capacity of the ordinary laboratory, if not cheaper than present methods.

A solution containing 20 per cent. by weight of grade RH-393 PVA is prepared by suspending the powder in cold water (about 20° C.), breaking up the lumps, then stirring well while heating in a steam-bath to a temperature of 75–85° C. To the cooling solution is added 20 per cent. of glycerine by weight. Washed formalin-fixed tissue, without further preparation, is placed in this material in covered shallow dishes. Infiltration of ordinary tissues, as heart, lung, liver, spleen, etc., using pieces of average size, is as good when they are put directly into 20 per cent. PVA as when they are run through 5 per cent. and 10 per cent. first. The dishes are kept at room temperature but for a daily exposure of two hours to a temperature of 56° C. in the oven. Solidification takes place in 8 to 9 days. The total time may be shortened by cautiously uncovering the dish toward the end. The trimmed block of hardened PVA is attached to the fibre carrier-block with paraffin or with cement. The cut sections unroll in lukewarm water and are mounted immediately for staining. The medium is not washed away, but stains no more than does celloidin. The remaining procedures are as usual.

This is a preliminary report. Further experimentation in progress is aimed at eliminating heat and at shortening the procedure. The protean qualities of this plastic make such improvements highly probable.

We should like to thank E. I. du Pont de Nemours and Company for supplies of PVA and for considerable advice.

VIRGINIA LUBKIN
MARY CARSTEN

OPHTHALMOLOGICAL LABORATORY,
MONTEFIORE HOSPITAL,
NEW YORK

X-RAYS FROM RADIO TUBES

IN 1937 Simons, Clark and Klein[1] described a simple apparatus for the generation of x-rays from an old 01-A radio tube, the total cost of the equipment being something like $25. The purpose of the present note is to describe a simplified form of the apparatus, which can be assembled at an expense of six or seven dollars and which is remarkably effective for making radiographs of various specimens.

The materials required are:

Two Ford model T ignition coils (KW brand).
A step-down transformer, from 110 to 12 volts (if unavailable, two 110–6.3 volt transformers commonly used in radio circuits can be substituted with the 110-volt sides connected in parallel and the 6-volt sides in series).
An old 01-A radio tube.
A small wedge of sponge rubber.
Some No. 22 wire for hook-up connections.
A small portion of a metal foil.

The two spark coils are connected in series by connecting the two terminals nearest the vibrators together. The 12-volt source is connected to the two terminals on the ends opposite the vibrators. The 110-volt end of the transformer is connected with a 110-volt line source. One of the vibrators is turned down tight so that it does not operate. A wedge of sponge rubber is slipped under the other vibrator to produce the maximum frequency possible. This adjustment takes about five minutes. One high tension lead is connected with the four prongs of the base wired together and the other with the foil wrapped around the upper part of the radio tube. The foil should not cover the portion of the tube facing the flat side of the plate element inside where the x-rays originate. The radio tube should be mounted on an insulated support, for the voltage is about 16 KV to ground with about 32 KV between the two high-tension terminals. A small glass tumbler, with a strip of adhesive tape, makes a good support. Radio tubes displaying a green fluorescence produce an x-ray beam of greater intensity than tubes showing a blue fluorescence.

For making radiographs at a distance from the radio tube to the object of four to six inches and with Agfa non-screen x-ray film held in double black paper envelopes, the time of exposure is from two minutes for thin objects to five minutes for thicker ones.

Excellent radiographs of objects such as seeds, fountain pens and other fabricated objects, gems, flowers, bones, etc., are easily obtained. The apparatus is also particularly well adapted for microradiographs, in which the radiograph of small specimens is registered on a fine-grained photographic emulsion and enlarged as described by Clark and Shafer.[2]

HOWARD C. BRINKER

ST. PAUL, MINN.

[1] *Radiology*, 29: 721, 1937.

[2] Transactions of the American Society of Metals, p. 732. 1941.

BOOKS RECEIVED

BENT, ARTHUR CLEVELAND. *Life Histories of North American Flycatchers, Larks, Swallows, and their Allies.* Pp. xi + 555. 70 plates. U. S. Government Printing Office. Paper, $1.00.

Contributions to the Calculus of Variations, 1938–1941. Pp. vii + 527. University of Chicago Press. $3.00.

HAYNES, WILLIAMS and ERNST A. HAUSER. *Rationed Rubber.* Pp. vii + 181. Alfred A. Knopf, Inc. $1.75.

HOLLINGWORTH, LETA S. *Children Above 180 IQ.* Pp. xvii + 332. World Book Company.

Physics of the Earth. IX—Hydrology. Edited by OSCAR E. MEINZER. Pp. xi + 712. Illustrated. McGraw-Hill. $7.50.

TSCHAN, FRANCIS J., HAROLD J. GRIMM and J. DUANE SQUIRES. *Western Civilization. The Decline of Rome to 1660.* Pp. 783 + xciii. Illustrated. J. B. Lippincott. $3.25.

SCIENCE NEWS

Science Service, Washington, D. C.

PAPERS READ BEFORE THE MINNEAPOLIS MEETING OF THE INSTITUTE OF FOOD TECHNOLOGISTS

E. M. CHACE, of the U. S. Department of Agriculture, speaking before the meeting of the Institute of Food Technologists at Minneapolis stated that a hundred tons of cabbage a day, with similar mountainous quantities of onions, garlic and other vegetables, are being reduced to the bulk-saving, weight-saving dehydrated form in California processing plants formerly devoted to drying fruits. When the procurement officers for American armed services and purchasers for the lend-lease program made known their huge-scale requirements for dehydrated vegetables, the first response was the conversion of the large fruit-drying plants. Some new establishments have also been set up. Mr. Chace, and also Professor S. C. Prescott, of the Massachusetts Institute of Technology, who spoke on the same program, warned against an over-enthusiastic rush to get into the food-dehydrating business. Several limiting factors impose themselves. Food dehydration is not the simplest job in the world, and the number of men with adequate technical training is relatively small. Equipment also is a problem, because a certain amount of critical metal is needed for construction of a plant, as well as cutting and other processing machinery which may be difficult to obtain. Finally, despite the gargantuan requirements of Army, Navy and Lend-Lease, their buyers are not rushing into the market to grab up dehydrated foods no matter by whom offered.

Despite their superior resistance to spoilage due to attacks of molds, bacteria and other outside organisms, dehydrated foods sometimes lose quality in storage. They become tough, or develop hay-like "off" tastes and odors. Causes for this were traced to the vegetables' own internal enzyme chemistry by Professor W. V. Cruess and Professor M. A. Joslyn, of the University of California. These enzymes are organic catalysts or ferments, necessary to the normal life activities of the plants, but damaging to their quality as foods if permitted to continue activity after harvesting and storing. In vegetables properly prepared for the dehydrator, all such life processes are stopped by steam or hot-water blanching. Several chemical tests were described and recommended for determining the amount of enzyme activity persisting in dehydrated vegetables.

The Great American Tin Can is rapidly learning how to get along on war-short rations of tin, or even to dispense with tin altogether. H. R. Lueck, director of research for the American Can Company, told of progress made in this direction. Complete tinlessness is attainable for certain types of container by a process known as "bonderizing" the steel plate. It is not a new process, having been used in the automobile industry for some years, but is only now being adapted for food containers. Bonderized cans do not have high resistance to the acids usually present in canned goods, fruits and vegetables, but the treatment adapts the metal surface to the reception of protective plastic coating. Where tin is available, and necessary because of the nature of the can's intended contents, great economy can be effected by the relatively new electro-depositing method. Tinplate manufacturers, Mr. Lueck said, are rapidly getting their plants into shape for using this coating technique.

Paper, cardboard, cellulose sheeting are being used as substitutes for tin. E. A. Throckmorton, of the Container Corporation of America, told of some of the ingenious ways in which manufacturers of non-metallic containers are meeting the war emergency in packaging. Greater strength and lower loss of contents are sought by bonding together materials of different kinds, forming a laminated structure. Thus, an impervious cellulose sheeting may be bonded to a strong cardboard backing, to make a package that will take hard jolts and not leak.

Indium, a rare metal which hardly anybody but chemists have ever seen, may become familiar as a shiny lining in toothpaste and shaving cream tubes, was suggested by Albin H. Warth, chemical director of Crown Cork and Seal Company. Indium is so new as a commercial metal that until as recently as 1924 only one gram (1/28 ounce) had been prepared in pure form. Since then an American corporation has been extracting it from its ore, a large deposit of which was found in Arizona. Although the metal is still very expensive, a very thin coating within a lead tube will suffice to protect the contents. Mr. Warth also pointed out that the packaging problem is not merely one of finding substitutes for tin, copper, cork and other scarce materials, but of devising packages in the making and filling of which existing machinery can be used with little modification. Otherwise quantities of steel and other critical materials will be required for new machinery. Paper, he said, has been heralded as a substitute for almost everything. But to make it moisture-proof it must be impregnated with suitable resins, themselves very scarce, resulting often in a very expensive package. The real problem is to secure coatings on metal that are resistant to sterilization temperatures. This is very difficult in view of the shortages of tung oil and synthetic resins.

A quicker way of cleaning milk cans, thereby permitting more rapid circulation of these vital food containers with corresponding reduction of the amounts of metal tied up in milk cans, was described by V. Schwarzkopf, vice-president of the Lathrop-Paulson Company, Chicago. The steam used in cleaning the cans is acidified with gluconic acid. After some experimentation it has been found possible to dispense altogether with the use of alkaline cleansing agents formerly used, thus releasing them for other essential war industries. Gluconic acid, formerly a chemical rarity costing dollars an ounce, is now a chemical commonplace costing only a few cents a pound because investigators of the Department of Agriculture some years ago discovered a strain of molds that would make it rapidly and in large quantity out of a glucose solution.

Drier and better dried beef, prepared in a few hours instead of the two to four months now required, was promised by R. C. Newton, vice-president of Swift and Company. The new product has a moisture content of only 8 per cent. to 10 per cent., making for better keeping qualities and economy in packing space and shipping weight.

An American wartime version of the "guns or butter" dilemma was presented by Ellery H. Harvey, director of research for Anheuser-Busch, Inc., of St. Louis. Nickel is needed for making tougher armor for warships and tanks. Nickel is also needed in the catalysts that tie hydrogen into vegetable oils to make creamy cooking fats and firm margarine. What is used for one purpose can not be used for the other. So chemists and physicists must find either another kind of hydrogenating catalyst containing no nickel, or devise means for making the present ones more efficient.

FUEL FOR DIESEL ENGINES

OBNOXIOUS smoke and odor in the exhaust gases of Diesel engines, now increasingly used in truck and bus service, can be reduced to insignificant proportions by use of fuels of higher cetane number and higher volatility, and selection of a fuel adapted to the engine used. (The cetane number is to a Diesel fuel what the octane number is to gasoline.)

This conclusion was reached, after testing 13 commercial fuels and 60 specially made up fuels in several different engines, by R. S. Wetmiller, engineer of the Texas Company, and Lieutenant L. E. Endsley, Jr., formerly an engineer with the Texas Company. Their findings were reported at the Peoria meeting of the Oil and Gas Power Division of the American Society of Mechanical Engineers.

The engine must be in first class condition. Improper adjustments, worn or dirty fuel injectors, or any other lack of proper maintenance can completely overshadow any benefits derived from use of a premium fuel.

However, while increase in cetane number and in the volatility of the fuel will diminish smoke and smell in the exhaust, they also decrease the power and economy of the engine. The solution must therefore be a compromise among the ends desired.

Prevention of excessive smoke and smell is especially important in view of the fact that they are worse when the engine is idling or accelerating after idling, operations that occur most frequently in our crowded city streets.

Hope was expressed that future engine design might obviate the necessity for "tailor made fuels" and precise maintenance.

VITAMIN C PREVENTS HEAT CRAMPS AND HEAT PROSTRATION

HEAT cramps and heat exhaustion, summertime menace to some people, but a year-round danger to men working in steel mills, foundries, ship-yards, in engine rooms of naval and transport ships and to troops in the tropics, can be prevented by doses of vitamin C, was stated by Dr. John H. Foulger, director of the Du Pont Company's Haskell Laboratory of Industrial Toxicology. This vitamin has also proved effective in treating heat prostration when it does occur, Dr. Foulger said.

Vitamin C, the anti-scurvy vitamin of citrus and other fruits, is soluble in water. Consequently even people eating a normal amount of it in their food each day may lose large amounts by sweating it out as salt is lost from the body with the sweat. Salt loss has long been recognized as a cause of heat cramps and heat prostration.

The vitamin is apparently needed, Dr. Foulger explained, to maintain muscle tone both in the large muscles and in the small ones of the blood vessel walls. This tone, a slight but sustained contraction of healthy muscles occurring even when the body is at rest, is necessary to help move the blood in the veins back to the heart. In heat prostration there is a loss of tone and a consequent collapse of the circulation, aggravated by the dilatation of the skin vessels in an effort to pipe more heat-laden blood to the surface to be cooled.

Success of the vitamin C pills in preventing heat cramps or exhaustion was obtained in a trial of their effect on 30 men who had to do a repair job on a "hot spot" over a drying cabinet up under the ceiling of a plant in the south. On similar jobs in the past a number of men had suffered heat cramps and heat prostration.

These men were given two vitamin C tablets daily by the plant physicians. Not a single man suffered either heat cramps or exhaustion during the entire job, which lasted several weeks at temperatures usually far above 100 degrees Fahrenheit and with very high humidity. After the job was finished the men reported feeling just as fit as they had when working at ordinary temperatures and asked to be allowed to continue the vitamin C pills.

The morale vitamin, B_1, also dissolves in water and may be lost from the body with the sweat. So workers in this plant are now getting daily pills containing not only salt but also vitamins C and B to help protect them from heat cramps and heat prostration. The vitamin treatment has been recommended for workers in all ordnance plants which Du Pont is operating for the government.

THE TEACHING OF AIR AND MARINE NAVIGATION

THE importance of unified and simultaneous instruction in air and marine navigation, and the importance of training college students in the operational routine of navigation rather than in old-fashioned principles were stressed by astronomers discussing the teaching of navigation at the meeting in New Haven of the American Astronomical Society.

Dr. John Q. Stewart, of Princeton University, said that pretraining in navigation of the better-equipped college students had received the approval of high officials in the Navy. Service schools do not have time to insure the thorough mastery of navigation operations which are essential to avoiding disaster during military maneuvers, and they are also in great need of instructors in the paperwork of navigation.

College courses on navigation should include the latest methods of air navigation along with the older marine methods, Dr. Stewart said. This is particularly important

in view of the growing cooperation between surface ships and air forces, which requires mutual understanding among navigators.

"It is not necessary to have a preliminary course in trigonometry and logarithms," Dr. Stewart stated, "far less in spherical trigonometry." He stressed that navigation must be taught as an operational routine. "Graphical methods, linear interpolations, and judgment of tolerances should be taught well."

Standard Hydrographic Office terminology ought to be used by all books and teachers of navigation, regardless of whether in air or marine phases. Dr. Stewart regards it as troublesome that manuals of navigation have been written for civilian and army pilots which deviate unnecessarily from standard methods and nomenclature. He recommended that the college teacher use Bowditch, the navy aircraft manual, the maneuvering board manual, and Dutton's book on navigation.

Relative motion was stressed by Dr. Newton L. Pierce, also of Princeton, as especially important in modern warfare. Navigation also includes piloting, dead reckoning, radio navigation, celestial navigation, and problems. Of these, only celestial navigation is strictly astronomical, yet hundreds of astronomers are called upon to teach the entire subject in the war emergency. Their students, in turn, become instructors of civil air corps pilots, army and navy men, and in civil aeronautics courses.

"Relative motion," said Dr. Pierce, "has been underemphasized and often badly garbled in the various texts which treat of it at all. It is true that relative motion has little use in peace-time marine navigation. It is, however, of great importance in war time for fleet maneuvers, and is important at all times for the air navigator. However, this is not a subject the student easily understands, and, therefore, it should receive considerable emphasis, particularly by vector solutions, which may be made easily and quickly. The Princeton astronomers recommended that the methods of solution of navigational problems used by the service schools be followed, and that the air almanac be used in preference to the nautical almanac wherever possible.

ITEMS

THAT the average length of life in America, at least among wage-earners and their families, has almost doubled during the past 60 years, is announced by the Metropolitan Life Insurance Company. Average length of life to-day, computed on the basis of mortality among the industrial policy holders of the company in 1941, is 63.42 years. During the period 1879 to 1889 early records show that the expectation of life for a one-year-old baby was 40 years. But deaths among infants were very much more frequent in those days than now. From other records relating to that time it is known that the expectation of life at birth, or the average length of life, was about 34 years, only a little over half what it is now. The average industrial policy holder 35 years old to-day still has as many years of life before him as the child in the wage-earning family of 1879 to 1889 had at the time of its birth.

WORK has started on three more 108,000-kilowatt Westinghouse generators, largest in the world, for the Grand Coulee Dam to power aluminum plants and other war industries in the Pacific Northwest. Three others of the giant units have been under construction since last August, and three are already installed at the dam. Each generator, big as a house, is 24 feet high, 45 feet in diameter, and weighs 1,000 tons. Thirty-eight freight cars are required to transport it in pieces to the dam. The largest single piece weighs 75 tons. The 74-foot shaft weighs 153 tons and is transported in three pieces. Ultimately Grand Coulee will have 18 of these 108,000-kilowatt generators, making it the largest power plant in the world.

METHODS of protecting radium during an air raid so that it will not be scattered by a bomb explosion have been recommended by the National Bureau of Standards. The rules were drawn up by a committee of physicians, engineers and scientists appointed by Dr. Lyman J. Briggs, director. They aim at safe storage of the radium with maximum protection and minimum interference with use. The committee advises extra precautions for 500 miles inland.

THAT malaria germs, and probably the germs of other diseases as well, can be frozen at temperatures colder than 100 degrees below zero in the Fahrenheit scale and kept at that extremely frigid temperature for as long as seven weeks without damage, is announced by Dr. Reginald D. Manwell, of Syracuse University. His method, so far applied only to germs of bird malaria, consists of instantaneous freezing of the germs in a small amount of the birds' blood in a test tube by whirling the tube at high speed in a mixture of alcohol and dry ice. Thawing within a few seconds is required to avoid killing the germs when the scientist wants to examine them or use them for other experimental purposes. Saving of urgently needed shipping space and reduction in expense will be one result of Dr. Manwell's achievement, since germs can now be shipped frozen in small containers from one laboratory to another, instead of in the bodies of guinea pigs, birds or other laboratory animals requiring bulky cages and special handling en route.

DISCOVERY of a method of preventing mercury poisoning among miners of this stategic mineral is announced by Dr. Merle Randall, professor of chemistry at the University of California. Because the war has cut off imports, the United States is now producing all its own mercury. Miners exposed to the vapors of free quicksilver, or mercury, however, are sickened and disabled and can only work a few days or weeks where the exposure is great. Careful ventilation, previous best method of prevention, has never been entirely satisfactory. Spraying the walls of mercury mines with a spray containing calcium polysulfide, Dr. Randall discovered, provides a coating through which the mercury can not vaporize. This method has been tested over a period of 11 months during which not a single case of mercury poisoning has been reported where the spray was used.